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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

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The Manchester Conference

"An unqualified success" was the verdict unanimously accorded by the two hundred odd participants in the one-day Conference of the Institute of British Foundrymen held in Manchester last Saturday. Into this day, skilful organisation managed to pack meetings of the Technical, the Literary and Awards, and the Finance Committees; an informal luncheon; the Annual General Meeting; the Presidential Address; and two simultaneously-held technical sessions. Major R. Miles, the new President, is already extremely popular in foundry circles, as was evinced at a very early stage by the presentation of a silver tankard from the Lancashire Branch. War conditions apart, Major Miles has a difficult task in following so deservedly popular a figure as Mr. W. B. Lake as president. Unlike the situation in many other institutes, this position is no sinecure, for the members have learnt to expect, and under normal conditions have invariably obtained, much personal service from the president. Not only is attendance at Executive and Council meetings assumed but also each branch likes to see the President personally present at their annual dinners, and there are many Branches! By his untiring energy and good fellowship Mr. Lake has endeared himself to every member of the Institute.

The new president in his inaugural address directed the thoughts of his audience to matters of the utmost importance, using incisively the weapon of innuendo. It is obvious from his remarks that whilst reasonably satisfied with research and technical organisation of the industry, he, like most of the scientifically minded within its ranks, is at least apprehensive of its future conduct from the angle of employer-organisation, and everything it stands for.

Mr. Howard Wood's promotion to senior vice-president has met with general approbation on account of his devoted services to the Institute over a long period. The awards made this year were as popular as they were well merited. Mr. Percy Pritchard, the recipient of the E. J. Fox Medal, has, since the last war, built up a whole chain of iron and light alloy foundries of the most modern type; this work, much of a pioneer character, has made a very serious contribution to the British war effort, especially in the air—a fact well recognised in both Governmental and technical circles. The Oliver Stubbs Medal went to Mr. J. J. Sheehan, of the Austin Motor Company, mainly in recognition of his work on the institution of scientific control in connection with foundry sands. The Institute is perhaps unique in this country inasmuch as it appreciates good work not necessarily associated with science and technology. Thus the Executive Committee was pleased to recognise, by the award of a Meritorious Service Medal, the efforts made by Mr. H. W. Lockwood in the promotion of the best interests of the Institute through the numerous official positions he has held over a number of years. Though only three diplomas were awarded this year, it must not be thought that there has been any lowering in the standard of Papers presented. It so happens that most of the authors are already recipients of this honour.

The four Papers presented at two sessions were well chosen, covering as they did entirely different fields. Mr. Pearce's Paper, which, *inter alia*, establishes a relationship between the tensile and transverse strengths of pearlitic cast irons, afforded a good opportunity for a general discussion on specifications, and problems connected with the making of high-duty irons. The Paper presented on behalf of the American Foundrymen's Association by Mr. Norman J. Dunbeck, supplied knowledge, much of which was fresh to the great majority of British technicians. The differentiation between the two types of bentonites was of outstanding interest. "Moulding Steam Valve Lids for Marine Service," by Mr. Frank Hudson, represents what is undoubtedly a most useful type of Paper, for it is the concrete symbolisation of the help which the scientist is giving to the practical man through the channels of the Institute. Moreover, it induced a second expert, Mr. McManus, to reinforce Mr. Hudson's precepts by illustrated examples from his own practice. The Paper on "Mould and Core Washes," from the versatile pen of Mr. W. Y. Buchanan, is yet another instance of the help which can be given by scientists who refuse to leave uncontrolled any foundry process capable of giving rise to defective castings.

The Manchester Conference, shorn as it was of all social functions, has acted as an excellent tonic to a hard-working group of technicians forced by circumstances to concentrate on war production to the exclusion of most other activities.

Wartime Adjustment of Debts: The New Act

By F. C. TEBBUTT

The Liabilities (War Time Adjustment) Act, 1941, is a measure designed to keep persons hit by the war, out of the bankruptcy court, and the procedure introduced is entirely new. Some notes explanatory of the Act will therefore prove useful at the present time.

Schemes of Arrangement

Under the section of the Act dealing with schemes of arrangement, a debtor can call upon a Liabilities Adjustment Officer (there will be one for each County Court district) for advice and assistance, so that an equitable scheme of arrangement can be arranged between the debtor and his creditors. If all the creditors and the debtor agree to a scheme, the officer approves, and it then has legal effect, and no recourse to a Court is necessary; even if only a majority of the creditors agree, the scheme can be approved, but any dissenting creditor has the right of appeal to a Court (normally the County Court, but in certain cases the High Court).

If the debtor is carrying on a business (or would be, if war circumstances had not intervened), efforts must be made to evolve a scheme which will enable him to preserve the business or to recover it when circumstances permit. Provision can be made in any scheme, for the composition of debts, the postponement of payment of debts, the assignment or charging of any property of the debtor in favour of the creditors, and the management or disposal of the debtor's business or any other property of his; furthermore, if the other parties agree, the terms of any lease, mortgage, or contract to which the debtor is a party may be varied.

Liabilities Adjustment Orders

Where debtor or creditors cannot agree to an arrangement, the case can be taken to the County Court (or High Court in certain cases) on the grounds that, owing to war circumstances, the debtor is unable to meet his obligations, or is in such a position that, if required to pay his debts and to meet as they fall due any future liabilities in respect of obligations already incurred, he would have no prospect of preserving or recovering his business, or would otherwise lose his means of livelihood. This means that a debtor can apply, even though he is in a position to pay his debts, but that, if he did so, he would be unable to carry on (or receiver) his business adequately; as, for example, stock may have been sold without opportunity of replenishment at the moment, and so capital is in debtor's possession.

If the Court opines that the case merits consideration, "a protection order" is first issued, which could be rightly called a standstill order, as then all proceedings are stayed; while this is in operation the Court looks further into the case and, if satisfied that the conditions allowing the application (explained earlier) are fulfilled, a Liabilities Adjustment Order is issued.

Such an order will state whether the debts are to be paid in full or at something less than 20s. in the pound, and how and when payment is to be made. To carry this into effect, the Court has power to realise any of the debtor's property (already existing or becoming available), and for the distribution of the proceeds and of any other sums, including such sums as the debtor may be required to pay out of his future income. The Court, however, has discretion to postpone realisation of any property which may be temporarily depreciated in value for any other sufficient cause.

Furthermore, the Court may provide for the maintenance of the debtor and his family, and may except from any property to be realised, premises used (or which would have been used if war circumstances had not intervened) as a home by the debtor and any furniture, bedding and clothing of the debtor and his family, and (if any) the tools of the debtor's trade.

If there is a business (whether currently operative or suspended by war circumstances), the business and the business and other necessary premises will invariably be excepted from any property to be realised, the Court having discretional power and also power to postpone the payment of any or all of the debts, and to allow the debtor to borrow sums for the purpose of the business, at the same time providing for repayments and for the payment of interest on these sums. In these business cases, however, it is specifically laid down that, in exercising its powers, the Court must have regard to the prospects of the business and the likelihood of ultimate benefit to the creditors as well as to the debtor.

Other Important Points

If premises are held on a lease or tenancy (the Court intending the debtor to retain the premises; the Court can disclaim leases, contracts and other property if thought onerous), provision may be made in a L.A. Order for a reduced rent, but only if the lettable value has fallen by war circumstances, and the rent cannot be less than the lettable value at the date of the Order. It may, however, be less than that permitted under the Rent Acts, if the hereditament is one under those Acts.

Where the debtor holds hire purchase goods, with sums unpaid, the Court has power to vest these goods in the debtor, the owner (*i.e.*, the seller) then proving for the balance of the Hire Purchase price. Consideration must be given to the value of the goods at the date of the order and the sums already paid, and the goods may be vested immediately or only after further sums have been paid; furthermore, the Court cannot exercise this power of vesting before the debtor has paid sums amounting to at least the value of the goods at the date of the order.

The Effect of Antimony on Magnesium

Prof. W. R. D. Jones and Mr. L. Powell have drawn the following conclusions in a Paper which they have prepared for presentation to the Institute of Metals, covering the effect of antimony on magnesium:—(1) The alloys are readily melted and can be easily cast. (2) The solid solubility of antimony in magnesium is very small, being less than 0.1 per cent. at temperatures up to 500 deg. C. and less than 0.2 per cent. at 550 deg. C. (3) The alloys are not capable of age-hardening. (4) The addition of antimony to magnesium causes no increase in tenacity or ductility either in the cast condition or after heat-treatment, but there is an improvement in the proof stress. The rate of decrease in the mechanical properties of cast bars with increasing antimony content reaches a maximum with ½ to 1 per cent., after which the decrease is not as serious. The mechanical properties are improved by annealing at 450 deg. C.

(5) Ingots containing up to 4 per cent. antimony can be readily hot-rolled, yielding bars with a higher tenacity and proof stress than rolled magnesium. Prolonged annealing at 350 deg. C. gives improved tensile properties. The ductility figures are, however, low before and after annealing.

(6) Pure magnesium is known to be weak mechanically and the addition of antimony makes it, in general, appreciably weaker.

(7) The addition of antimony to magnesium does not confer any notable corrosion-resisting properties.

Random Shots

This year's Conference of the Institute of British Foundrymen was a one-day event, though one little party is reported to have lingered so late as to make it necessary to stay the night in Manchester *sans* pyjamas and *sans* nightie, thereby keeping alive the old tradition of members attending conferences with most embarrassingly incomplete kit.

* * *

Yet another tradition was kept alive by the inclusion of Scotch salmon (or should it be Scottish salmon?) in the menu. However, the grand illusion that times have not changed could not be harboured for long, for someone was heard to murmur what would be in normal times a unique grace: "Thank God for salmon!" And that from a member who had not missed a conference luncheon for nigh on twenty years.

* * *

Then there was, of course, the traditional joke at Mr. Makemson's expense. Mr. Wood, in proposing him once again as Secretary, said that he had now proposed him so many times that he thought that it was about time that Mr. Makemson did a bit of proposing himself.

* * *

There was, too, an extraordinary coincidence, or could it be divination? On being elected as scrutineers for the fifth year in succession, Mr. Lockwood was heard to remark to Mr. Cook that if they carried on with the same job ten more years, they would be eligible for the Meritorious Service Medal. Very shortly afterwards Mr. Lockwood was, in fact, awarded that self-same medal!

* * *

Amusement was caused later in the evening when a plump and portly pageboy bounced into the lounge of a local hotel calling out, "Mr. Mussolini, please!" "He's hiding round the corner with Mr. Hitler," replied a merry *conferencier*.

* * *

During the conference Major Miles, the President-Elect, was presented with a silver beer mug by the members of the Lancashire Branch. He at least need not meet with the same fate as one poor traveller who, arriving tired and thirsty, after a long day on the road, at a country pub, asked for half a pint. "Have you got a glass?" demanded the barmaid. "I'm sorry I haven't," replied the motorist. "Well, I'm sorry I can't let you have any, then," was the firm and disappointing reply. However, knowing that the next public-house was not more than two miles farther on, he stepped on the gas and went to it. He arrived there to find the bar empty, so, seizing the first empty glass that he could find, he shouted for the barmaid. "Half a pint, please, miss," cried he, in joyful anticipation. "Have you got a glass?" inquired the fair Hebe. "Oh, yes, I've got my glass all right this time," he answered, pushing it proudly along the counter.

"That means you've had one already," snapped out the not-now-so-fair Hebe, "and I can't serve you another!"

* * *

Incidentally, one of the chief obstacles met *en route* by members travelling to the conference from various parts of the country was a swarm of miners going on holiday! "But we're not shirking us jobs," said one spokesman, "work's got to stop any'ow for a few days while they put on new winding ropes, so we're out to get a breath of fresh air." "Aye," added his mate, "we're not going to let Mr. 'itler spoil us morarly, not us!"

"MARKSMAN."

The Future of the Foundry Industry

MAJOR R. MILES' PRESIDENTIAL ADDRESS*

Mr. Lake and Gentlemen,—When you honoured me by making me a Vice-President, it occurred to me that, in my presidential address, it might be appropriate to make a general review of the development, present position and prospects of our industry. For obvious reasons it is not opportune at the present time to disclose facts and figures of an industry that plays so important a part in war production. I will, therefore, restrict my remarks to a few general observations connected with the war; and later, perhaps, put forward a few suggestions concerning post-war conditions.

A foundryman is essentially a man who learns from experience, and our experience of previous wars, whether vicariously by our reading of history, or directly, as in the case of a number of us, who were engaged in the last great war, seems to show that, however dislocating they may be at the time, wars are only episodes in the general progress of mankind. If, therefore, we continue our habit of basing our future practice on experience, we must be led to the conclusion that whatever setbacks the present war may produce, whatever discomfort or sorrow we may feel as individuals, the general progress of mankind will not be impeded, and our efforts, as scientists, and producers of commodities for the amelioration and advantage of our fellowmen, will in the long run be in no wise diminished.

It may be difficult to realise this, when, on the one hand, the skill and labour of our industry contribute to the strength of the perverted activities of the dictators, and, on the other hand, to our own power that will assist the natural overthrow of all dictators. Both antagonists are engaged in mutual destruction, and the destruction of many physical concomitants—at any rate, we have habituated ourselves to regard them as such—of a happy life. Not only do I sincerely believe that, however tragic it may seem at the time, war is only a temporary retrogression, but feel that if, owing to the frequent recurrence of wars, a man were to regard life as meaningless, he would be, as Einstein says, "not merely unfortunate, but almost disqualified from living." He goes on to say: "Each of us is here for a brief sojourn, for what purpose he knows not, though sometimes he thinks he feels a purpose. From the point of view of daily life we exist for our fellow-men. In the first place, for those on whose smiles and welfare our happiness depends. A hundred times a day I remind myself that my inner and outer life depend on the labour of other men, living and dead, and that I must exert myself to give in the same measure as I am receiving."

I doubt whether the benevolent scientist, when he said that he should exert himself "to give in the same measure as he was receiving" meant "an eye for an eye and a tooth for a tooth," but if the naturally pugnacious foundryman interprets the dictum literally in all its aspects, his justification will be that he is but hastening by apparently the only methods available, the return to sanity of those who have departed from it. In a world where abnormalities and aberrations exist, they must be dealt with whether they occur politically in a nation, or psychologically in any mass of people, in exactly the same way as they would be treated as a disease of the human body, or morbidity of an individual mind.

When such nations as the Huns have learned to shed their barbarity, other methods of dealing with diseased mass psychology will be employed, but in the meantime the surgical operation necessary requires the implements of war. "Give us the tools and we will finish the job." May such tools as we foundrymen provide be ample, and the job soon finished! Our immediate position, therefore, is clear. The future, however, is not so obvious.

The Future

When hostilities cease, and later, when the vast numbers of men and women engaged directly and indirectly for war purposes revert to peaceful pursuits, considerable forethought will be necessary to guide the change. The problem is exactly of the same magnitude as the change from peace to war, but operating in reverse, so to speak. Its speed will probably be no greater. The conclusion, therefore, is that it is almost inevitable that "Control" will persist for some years after the war.

For my own part, I regard this as desirable. Apart from war conditions, amalgamations into big units and co-operation amongst smaller units were growing tendencies. I am not convinced that schemes of nationalisation and socialisation of all industries have reached a stage of technique where it could safely be said that they would be accompanied by a higher standard of living; but I certainly am convinced that the popular school of economics to which the city in which we are meeting gives its name, is out of date and inapplicable to modern conditions. In other words, in large well-established industries such as ours, there will be no more *laissez-faire*, even though the devil may still take the hindmost.

A positive solution is particularly difficult when a fundamental economic basis is not clearly understood. The subject is a wide one, and it may be interesting for a moment to review our personal reactions. Though the ambitious and the materialistic minded amongst us may say that the monetary reward should be proportionate to our effort, the actual fact is, that most of us work because we have the habit of it, induced by the necessity for meeting our day-to-day responsibilities, and because we like it. I remember an old foundry foreman, working under me, who said, when given an unpleasant job, "If I weren't doing that I'd be doing summat else," and he would depart, cheerfully grumbling, and do the job well. I will not assert that the monetary reward has no bearing upon the effort, but I do emphatically say it is not the primary consideration. I would put a sense of security before it, but even the apprehension of insecurity is frequently an example of meeting trouble halfway. Much more important is the sense of enjoyment and satisfaction in doing the job itself.

There is, it seems to me, a mean, where for a reasonable, possibly a chance of an increasing, reward, and a reasonable sense of security for the future, happiness may be obtained in the actual performance of a job well done, to give service directly or indirectly to our fellowmen. Giving such service, not the actual pursuit of monetary reward, or even of personal happiness, should be the primary motive for our activity; for happiness is rarely the objective itself, but a concomitant. I have given prominence to the inwardness of the effects, because I regard it is most important.

"If solid happiness we prize,
Within our breasts this jewel lies."

As far as the outward effects of post-war conditions upon us as members of the foundry industry are concerned, I have already alluded to the probability of the continuation of control. Control, in our case, will have to be particularly widespread, as we very rarely sell our products direct to the final consumer. For the most part, our products are raw materials upon which there are numerous operations, such as machining and assembly. Hence, from the point of view of the market—without which we cannot produce—any national plan to serve the foundry interests cannot restrict itself to the foundry interests alone. It will have to form part of a much wider plan. The same, however, does not apply to the actual operations of production, wherein we as a technical institution are mostly concerned. Here the industry must have individual consideration, though no doubt the methods employed will conform with the general principles that may be laid down for similarly placed trade. The characteristic feature of the foundry industry is one that will make any national plan of production very difficult. I allude to the participation in the industry of a comparatively large number of small, privately owned, foundries. Again, I am skirting a wide subject, but this question of the size of a producing unit can be determined simply on economic grounds. If the small foundry can deliver castings to the market better and cheaper than the large one, such castings will be made in small foundries.

In case it should be observed that this is the first time I have used the word "cheaper," I would interpolate that I am assuming that under any system of production, whether for private profit or otherwise, a product should be made with the least ultimate expenditure of man-power value.

Utilisation of Leisure

I would say that we have not yet reaped the full benefit of the release of man-power by mechanised systems of production. We have certainly reduced the working hours in the week, and must, of course, use further man-power in actually making the machines, and in the far more elaborate system of distribution now necessary. But I can visualise that we may be able, within this generation, to reduce the working week still further; to reduce the age of retirement; and to raise the school-leaving age.

I am not alluding to an immediate post-war period, when a starved world will probably be able to accommodate and consume goods that will require long hours to produce; but to a longer and more general trend, when interchange of commodities may again reach comparative stability.

This may seem irrelevant in an address to the Institute of British Foundrymen, and especially its corollary, that we should take our part in training ourselves and our workpeople to make proper use of any increased leisure. We have always had a strong educational bent in our Institute, and I have no doubt that we shall continue this, not only as an Institute in the specialised industrial direction, but as individuals in other directions, where the well-being of our workpeople is concerned. In this connection we should not forget ourselves, who for the most part, as far as my experience goes, have so very little time apart from our works' duties, that we only half-heartedly enjoy the little leisure available to us. What is the point of being, as I heard described a recently deceased foundryman, "The wealthiest man in the cemetery"?

I think that we have been especially favoured in this country, for my experience in many parts of the world is that our standard of living is comparatively high. The standard of education and the appreciation of the good things of life is certainly higher than in many other populous countries. This high standard, however, carries with it its obligation that it has to be earned. If, for example, our standard of educa-

* Address given to the Annual Conference of the Institute of British Foundrymen held at Manchester on July 12.

tion is higher, we should use our brains to give value in material advantages to those whose standard is lower, and who are willing to pay for such advantages in physical labour. Conversely, it is not possible to maintain the advantage of a higher standard of education if the outgoings necessary to attain this standard are lost in the production of commodities that require only physical labour to produce them.

Under to-day's rapid interchange, the lag in the adoption of ingenious mechanism is small. In other words, comparatively uneducated races can reproduce scientific methods of production quickly. We observe this in many parts of the world to-day, and this effect must be clearly envisaged when we endeavour to interchange our commodities, for the imported commodities we shall require, in the post-war period. Unless we have something of value, something that has risen out of our higher standard of living, involving higher educational attainment, and not the mere result of physical application which can be made by those with a lower standard of living, we obviously cannot maintain our standards.

Increased Research Effort Essential

Summarising this effect, to continue our higher standard, we must vigorously and successfully pursue our scientific research and development. We must not only bring such research to a successful academic conclusion, but we must see that steps are taken, by suitable propaganda, and otherwise, to ensure that a practical realisation of exchangeable value accrues from our efforts.

Hitherto I have presupposed a continuation of the requirement of our services, possibly on a restricted scale in some directions, but nevertheless continuing. That foundry products will be required after the war is certain, but their measure is not easy to determine. I have assumed that the foundry industry depends largely on the requirements for castings of other trades, and hence is normally largely dependent on such industries.

I think that foundrymen should not allow their work and their livelihood to depend on any third parties. We should ourselves take some initiative, in collaboration with these industries where necessary, and actively take all possible steps to ensure that the foundry industry participates in full measure in the post-war reconstruction. We are primarily a technical body, but all our technique will be of no avail unless the need for our production be assured.

The Institute of British Foundrymen is undoubtedly the strongest and most homogeneous comprehensive foundry organisation in the country. We have, on the one hand, research associations such as the British Cast Iron Research Association, entirely technical organisations, and, on the other, the various trade associations, becoming more comprehensive, in the industry. There have recently been attempts to consolidate the commercial side of the industry, which have not proved too fruitful, though such efforts are continuing, I hope, to a successful conclusion. A little display of sympathy by the Government would be encouraging.

The problems of post-war reconstruction are amenable, to say the least of it, to scientific approach. You gentlemen, for the most part, are scientists. I suggest, therefore, you bend your activities, when you are satisfied that, in accordance with the first part of my address, you are doing your utmost to end the war by producing the maximum means to that end, to devote your scientific minds to post-war problems; to take the initiative with your commercial colleagues to ensure that foundry services shall, in peacetime, continue to give the maximum benefit to the community.

It is a matter for our Council to determine whether we can take the initiative as an Institute, and continue a further and wider leading part in conditioning affairs so that the long-term trend of our industry shall be upwards. Whatever our conclusion, I repeat that *laissez-faire* will probably find us left without the fair deal, or we may revert to the situation where dog eats dog. With the elimination of wasteful internecine competition there will be more time to explore the infinite realms of progress. Within our short lifetime the art of founding has made revolutionary advances, and has embraced many new alloys and even several new metals; apart from the developments in the means of casting them, and all that it implies, which are our own special prerogatives.

I hope I end in an optimistic strain. We have a present duty to perform, to continue to take a leading part in helping to win the war. We have a future duty to perform: to use, jointly and severally, our scientific and other abilities, and our common sense, to ensure that our industry maintains its part in serving our fellowmen.

Noteworthy Progress of the Hydro-Blast Cleaning System

A recent issue of the "Iron Age" describes and illustrates an installation of the Hydro-Blast cleaning plant in the Advance Foundry Company, of Dayton, Ohio. This concern is essentially a jobbing shop doing between 40 and 50 tons of mainly machine tool castings a day. The new installation, the 11th to be made by the Hydro-Blast Company, is stated to have effected economies of the order of £20 a day, of which sand reclamation, at over £8 a day, forms a substantial part. Another factor is the retrieving in excellent condition of the core bars, gaggers and the like. The Hydro-Blast system, it will be remembered, is to introduce into the nozzle of a hosepipe functioning at 1,200 lbs. per sq. in. water pressure, abrasive sand and to direct the stream on to the portions of the casting to be cleaned. The nozzle lasts about 400 hours, for the mixture is very abrasive. For instance, tests have shown that 60 lbs. of dune sand entrained in 60 galls. of water per min. at 1,200 lbs. will cut away an average of 26 grms. of copper-bearing steel plate in an 8-min. test interval. Though the essentials of the system are extremely simple, there has had to be built up around it a somewhat complicated, but worthwhile, technique of sand recovery, and other useful features. For instance, the operators wear rubber suits and special helmets. To avoid the cold, clammy feeling in winter, the water is preheated to 80 deg. F., and for the purpose of cleaning the eye-pieces, every seven seconds a stream of water is automatically flooded over them. Another refinement is the addition of a rust inhibitor into the water system. In the particular plant described the water consumption is of the order of 90 galls. per min., when the machine is working. The sand is introduced at the rate of 2 cwts. per min., all of which, except the fines, is recovered. It does seem that the Hydro-Blast Corporation have now thoroughly established the system as a practical proposition in localities where heavy water consumption is a practical proposition.

Light Alloys in Ship Construction

A research scholarship of the value of £250 per annum and tenable for two years has been founded by the Wrought Light Alloys Development Association to encourage and facilitate research in the application of light alloys to ship construction. The scholarship will be administered by a Committee of the Institution of Naval Architects and it is hoped to make the award in September, 1941. Full particulars of entry, which closes on July 31, can be obtained from the Secretary, Institution of Naval Architects, 10, Upper Belgrave Street, London, S.W.1.

Book Reviews

The Practical Application of Aluminium Bronze. By C. H. Meigh. 112 pp. Published by the McGraw-Hill Publishing Company, London. 1941. Price 17s. 6d.

It is little more than two years ago since the Copper Development Association produced their excellent treatise entitled "Aluminium Bronze." Before that the modest handbook of the same title published in 1930 by the British Aluminium Company gave useful service. Mr. Meigh approaches the subject from a more individualistic viewpoint: his book is evidently the product of an independent mind interpreting in its own way the observations made during a lengthy period of practical experience.

The reader is left in no doubt about the author's enthusiasm for his subject. His uncompromising advocacy leads him occasionally on to ground which others may regard as controversial, as for instance when dealing with bronzes for bearings and pinions, but the author plumps for aluminium bronze every time. Nevertheless, the general merits of this class of bronze are well set out in the sections on "Properties and Uses" (Chapter I) and in parts of Chapters III and V on "Mechanical and Physical Properties" and "Wrought Aluminium Bronze." How to use aluminium bronze as distinct from why, is expounded in Chapters IV and VI on "Foundry Practice" and "Workshop Practice."

In Chapter II on "Micro-structure," and elsewhere, such terms as "crystal," "homogeneous microstructure" and "crystal slip," are used by the author to convey meanings different from those to which the metallographer is accustomed. Allowance has to be made for this, and due notice must be taken of the *ad hoc* definitions, explicit or implied, in the text if the argument as a whole is to be appreciated.

In the final section, Chapter VII, on "Faults and Failures," attention is paid to the effects of impurities, contraction cavities, corrosion fatigue and wear. There is a puzzling reference to intercrystalline penetration, and misguided individuals who continue to speak of "self-annealing" in aluminium bronze castings receive short shrift.

It is to be regretted that under the heading "Foundry Practice," Mr. Meigh does not touch on methods of melting and moulding. The *pros* and *cons* of fluxes, chokes, bottom running and top running are matters for lively debate whenever foundrymen discuss aluminium bronzes and they would have found special interest in a section dealing with these matters in the present volume.

It is obvious that a great deal of thought and experience has gone into the paragraphs and illustrations on "Design," and these will repay study by engineers wishing to take advantage of the attractive properties offered by aluminium bronzes in the cast form. The photomicrographs demonstrating the influence of variations in aluminium content and rate of solidification in binary and more complex bronzes provide strong support for the claim that these alloys lend themselves particularly well to close technical control in production.

The book is printed on extremely good paper and is attractively bound. This, in conjuction with war costs of production, probably accounts for the rather high price.

A.J.M.

Strength of Malleable C.I. Fittings

During an air raid, a wall was demolished, leaving a pipeline hanging in the air. One long length was joined to another pipe by means of a 1½-in. short pattern female GF bend, but whereas these pipes were originally fitted at 90 deg. the blast blew one pipe round so that the angle was closed to 42½ deg. No sign of fracture either at the radius of the bend or at the threaded joints was observed, so as a matter of interest this fitting was blanked off and tested to 360 lb. per sq. in. It remained perfectly tight at this pressure.

American Synthetic Sand Practice*

By NORMAN J. DUNBECK†

[AMERICAN FOUNDRYMEN'S ASSOCIATION EXCHANGE PAPER]

DEFINITION OF SYNTHETIC MOULDING SAND

When metal is cast against moulding sand, the clay contained in the sand close to the casting is dehydrated and it loses strength. It is further weakened by normal accretions of burned core sand. This weakened sand often is discarded, although it may be as good in refractory value and grain structure as when it was new. This is costly and inefficient. Many foundries now add bonding clays to restore strength, and in this way, effect elimination of new bonded sand or a considerable reduction in the amount used.

Bonding clays are strong plastic clays which develop strength rapidly, even when used in small amounts. They may be added to new or burned silica sand to form synthetic sand. Some sand producers now manufacture what is called synthetic sand by the addition of bonding clay to unbonded or low-bonded sand at the sand pits. As generally used in American foundry practice, however, the term synthetic sand covers any sand which is made in the foundry, as required, from materials selected and proportioned by the foundryman to best fit his particular needs. A rebonded sand is one whose usefulness or life is prolonged by the addition of bonding clay.

A certain amount of burned sand is lost from the foundry each day by adherence to castings. Common practice in making the synthetic sand is to add to the used sand enough clay bond to restore strength and enough silica sand to maintain volume. Since this silica sand and the core sand used are the only new materials entering the sand they will eventually compose the entire heap or system. It is, therefore, essential to select a grain-size of this sand which will give the finish and permeability required.

Synthetic sand has been used in steelfoundry practice for a great many years. Its use is so common that steelfoundrymen do not often speak of their mixtures as synthetic sands. The term, of course, describes such sand, but probably is used more often by ironfoundrymen in describing their combinations of bond clay and sands. The general procedure followed in cleaning, classifying and rebonding used sands is termed sand reclamation. The term clay-bond is a general one and may refer to fire-clay bonds, other plastic clays, bentonites or bentonitic clays.

The reclamation and rebonding of used iron-foundry sands reached substantial volume in the United States between 1925 and 1930 and has increased steadily since. It now seems probable that a larger tonnage of castings is made annually in synthetic sand than is made in naturally-bonded sands.

Some objection has been raised to the term "synthetic sand" because the word "synthetic" might imply that the material was a cheaper and inferior substitute for naturally-bonded sands. It has been suggested that the sand be called "artificial sand" or "manufactured sand." The term "synthetic" has been in use so long that it will probably be continued. It is worth noting, however, that the product is used because the user believes it to be superior as well as cheaper than the natural product.

The writer has also read occasional references in the British technical Press to the effect that synthetic sands are widely used in the United States because there is a scarcity of good naturally-bonded sands. There are deposits of high-quality naturally-bonded sands in almost all parts of the United States and they occur in enormous tonnages.

SELECTION OF MATERIALS

Base Sand

A synthetic sand may be made from all new unbonded sand and clay; from naturally-bonded sand and clay; from used moulding or core sand and clay or from combinations of these various materials. When it is proposed to rebond certain sand heaps it should be realised that there is a certain loss of sand on the castings of which only a portion is recovered. This loss must be replaced by daily additions of sand which may be any of the above materials. The original sand in the heap will eventually be entirely replaced by the sand in the daily addition resulting in a final mixture composed of the base material and bond. The final result is the same, therefore, whether a start is made with a completely new synthetic mix or whether rebonded old sand is the original material.

The base sand may be a bonded sand, a low-bonded sand or an unbonded sand. An unbonded sand is preferable since the clay in naturally-bonded sands is neither usually efficient nor refractory. The so-called bond in natural sands also frequently contains a substantial percentage of silt which adds little to strength, increases the amount of tempering water required and reduces permeability and flowability. Some low-bonded sands are desirable since the small amount of natural clay present provides a priming surface on the grains and substantially reduces the amount of bonding clay which must be added. Any final decision on base sand depends upon the delivered cost, a cheap local low-bonded sand being preferable to a costly distant unbonded sand.

The base sand is examined for these four properties: (1) Grain size, shape and distribution; (2) minimum clay content; (3) refractory value; and (4) minimum expansion.

The reasons for stipulating minimum clay content, minimum expansion and maximum refractory value are apparent. Some thought must be given to grain size, shape and distribution. While the type of bond clay used will have effect upon flowability and hence finish, it is true that fine finish is obtained only from fine-grained sands. While the type of clay will affect the permeability, it is still true that very high permeabilities are given only by comparatively coarse sands. One must, therefore, seek the proper grain-size for the work to be done. In the search for such sand grain shape and distribution must also receive attention.

For some years a perfectly round grain was considered the ideal. It is now realised that such round grains require a comparatively higher amount of bonding material and cause greater difficulty from cutting and scabbing than do sub-angular grains, which are preferable. It has also been found that many sub-angular grained sands give satisfactory permeability, and may even give higher permeability than some round grained sands despite all theories to the contrary. Burned core sand from oil-sand cores is an excellent material to rebond, as the grains have a rough surface and accept bond readily.

It was once thought that all fines should be eliminated and the sand grains concentrated upon as few screens as possible. It is now known that a certain percentage of fines is desirable, and that too heavy a concentration of grain on a few screens may give a sand having a pronounced tendency to rat-tail or buckle.

This is due to the close packing of uniform grains in a sand of high flowability. When the silica grains expand they break the mould face. A minor break causes a rat-tail; a larger break causes a buckle, and a still larger break causes a scab, although it is recognised that scabs are also caused by other factors. In the last case, the moving metal penetrates under the broken surface or removes a portion of the sand, replacing it with metal. These defects appear in maximum development in the cope of the mould.

The fines in sand have much higher expansion than the coarser grains, yet their addition to the coarser grains reduces expansion difficulties. It has been said that the fines provide a cushion between the larger grains, but the author believes that their corrective action is due to the simple fact that they reduce flowability, thus increasing the distance between the coarser grains in the rammed mould face. This seems corroborated by the fact that a very small addition of cornflour is the best-known method of stopping these cope defects, short of changes in the sand grain distribution; cornflour reduces flowability faster than any other common moulding material.

TABLE I.—*Relative Value of Various Types of Clays.*

	Kaolinite.	Illite.	Montmorillonite.	
			Southern.	Western.
Highest green compression strength ..	4	3	1	2
Highest dry compression strength ..	2	3	4	1
Highest permeability	4	3	1	2
Least tempering water required	4	3	1	2
Highest sintering point	1	4	2	3
Greatest durability	1	3	4	2
Highest flowability	3	2	1	4
Best collapsibility	3	2	1	4
Highest resilience	2	3	4	1
Least contraction at 1,370 deg. C. ..	1	4	2	3
Fewest lumps in shake-out sand	3	2	1	4
Least intensive mixing effort required ..	4	2	1	3

The present trend is to seek the bulk of the material on three adjacent screens with a few per cent. on possibly two more adjacent screens. Such a sand still gives high permeability in relation to its fineness, but the distribution is such as to reduce expansion difficulties. Some American foundries which use large quantities of oil-sand cores shake out as much as possible of the burned core sand into the sand systems and also return to the systems burned core sand which is carried away with the castings. It is then possible for them effectively to control the fineness of the system sand by varying the proportion of fine and coarse sand in their cores. This has been described more fully by Zirzow,[1] and his Paper is probably available in many United Kingdom libraries in the bound volumes of the A.F.A. Transactions.

In any moulding sand, foundrymen are interested principally in grain-size, green strength, dry strength, hot strength, permeability, durability, flowability, moisture required, resilience, expansion, contraction and sintering point. In selecting a naturally-

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* Presented at the 38th Annual Conference of the Institute of British Foundrymen, held at Manchester on July 12.

† Vice-President, Eastern Clay Products, Inc., Elfort, Ohio.

American Synthetic Sand Practice

bonded sand, there is the difficult problem of finding as many of these twelve properties as well developed as possible within an economical radius of location. In compounding a synthetic sand, only three properties must be found—grain size, permeability and expansion—as they are to be established in the base sands, and foundrymen can control the other nine properties to a substantial extent by their selection of clay bond to be used. Since there are many types of clays available, the problem of making a synthetic sand is considerably simpler than the problem of finding an equally satisfactory naturally-bonded sand.

Bond Clay

Almost any kind of plastic clay will develop some binding strength. Special clays are used, because the clay should not only give green strength, but must also develop dry strength; have a high sintering point; the ability to mix rapidly; good durability; adequate strength at high temperatures; moderate contraction at high temperatures, and other special requirements for specific problems.

The selection of the proper clay requires a knowledge of the essential properties of the

TABLE II.—*Effect of Changes in Quantity of Clay and Water on Hot Strength.*
Base sand, unbonded silica. Average grain fineness, 53.

Bond or combination.	Ohio fireclay.	Ohio fireclay.	Ohio fireclay.
Per cent. bond ..	12	12	10
Per cent. moisture ..	4.0	3.5	3.3
Permeability ..	85	87	103
Green compression	8.5	10.5	8.7
Green deformation	0.019	0.017	0.015
Dry compression ..	71.5	52.0	47.5
Hot strength :—			
260 deg. C. ..	55	52	38
535 „ ..	100	85	60
815 „ ..	153	87	80
1,040 „ ..	550	400	295
1,370 „ ..	5	6	5

general group of clays. Until a few years ago, there was considerable mystery even among clay producers themselves as to the reason for different results given by different clays. Recent work indicates that the mineral composition of clay is the most important single factor in determining results. Thus, two clays each having the same percentage of clay substance might deliver approximately the same strength if kaolinite was the principal mineral in the clay substance of each clay. Two other clays, each having the same percentage of clay substance, might differ very sharply in bonding value if kaolinite was the principal mineral in one, while the second was a mixture of kaolinite and illite (beidellite). In addition, the strength of a clay bond is affected by the percentage of clay substance and the type of ion absorbed on the surface of the clay particles. The importance of the adsorbed ion is clearly indicated by Western and Southern bentonites. These materials, which differ radically in physical properties, are practically identical in particle size and mineral composition, but the Western deposit carries basic adsorbed ions while the Southern carries acid adsorbed ions.

The high quality clays in each group can be expected to give generally similar results, but there is, of course, a wide range in quality between the best and worst clays in each group. If refractory clays of low bonding power are eliminated, the currently available American bonding clays may be grouped into three classes determined by their dominant mineral. These classes are given in Table I, together with their relative values for various properties in the production of synthetic sand. Comparison merely indicates the order from best to worst in each property.

Kaolinite Clays

Practically all of the refractory bond clays, such as fire clay and ball-clay, fall into this class and this is the most widely-used type of bond clay in the United States. Fire clays of excellent plasticity and refractory value are available in the United States and, as a result, the more costly ball-clays have not been able to justify entry into the market at their higher cost. The best of these fire clays have a fusion point of 1,675 to 1,705 deg. C.; a clay content according to A.F.A. methods (fineness 0.02 mm.) of about 95 per cent. and a clay content according to the pipette and hydrometer methods (fineness 0.005 mm.) of about 75 per cent.

There is a greater difference in value between the good clays and poor clays of this class than between the class itself and any other class. Any statements about these clays or the clays in following classes will refer to the best of the individual groups.

TABLE III.—*Hot Strength of Combinations of Bond Clays.*
Base sand, unbonded silica. Average grain fineness, 53.

Bond or combination.	S.B.	75 per cent. S.B.* 25 per cent. W.B.†	50 per cent. S.B. 50 per cent. W.B.	25 per cent. S.B. 75 per cent. W.B.	W.B.
Per cent. bond	4	3.8	4.3	4.8	5
Per cent. moisture	2.6	2.5	2.5	2.5	2.5
Permeability	178	180	171	160	167
Green compression	9.9	9.6	9.8	9.8	9.6
Green deformation	0.008	0.012	0.012	0.011	0.012
Dry compression	47.0	42.0	59.0	69.0	83.0
Hot strength :—					
260 deg. C.	21	31	38	43	75
535 „	35	42	53	55	74
815 „	30	70	160	175	195
1,040 „	25	65	90	95	490
1,370 „	3	4	5	4	8
Strength after cooling from 425 deg. C.	20	37	40	45	55

Retained strength after cooling from 425 deg. C. indicates quantity of lumps to be expected in shake-out sand
* S.B. = Southern bentonite. † W.B. = Western bentonite.

Illite Clays

Illite clays are not widely used in the United States, but they are here included because many naturally-bonded sands have illite as a major constituent in their clay content. There is wide variation in the value of various illites, but the best clays in this group have a finer grain-size than the kaolinite clays and develop somewhat higher green strength. It is necessary to use a lesser amount which results in higher permeability. They give good flowability and reasonably high sintering point. They have a moderate dry strength and a rather high contraction at high temperatures, whilst they have low durability as compared to the kaolinite clays.

They may be considered an intermediate clay with higher strength than the kaolinite clays, but much lower strength than the montmorillonite clays. Their use depends upon comparative delivered costs at any particular location.

TABLE IV.—*Hot Strength of Combinations of Bond Clays.*
Base sand, unbonded silica. Average grain fineness, 53.

Bond or combination.	O.F.C.	75 per cent. O.F.C.* 25 per cent. S.B.†	50 per cent. O.F.C. 50 per cent. S.B.	25 per cent. O.F.C. 75 per cent. S.B.	S.B.
Per cent. bond	12	9.25	6.5	5	4
Per cent. moisture	4.0	3.7	3.2	2.6	2.6
Permeability	85	118	139	167	178
Green compression	8.5	11.0	10.4	12.9	9.9
Green deformation	0.019	0.015	0.015	0.012	0.008
Dry compression	71.5	83.0	71.0	55.0	47.0
Hot strength :—					
260 deg. C.	55	54	35	40	21
535 „	100	59	50	48	35
815 „	153	100	62	30	30
1,040 „	550	450	238	85	25
1,370 „	5	5	5	4	3
Strength after cooling from 425 deg. C.	65	74	43	27	20

* O.F.C. = Ohio fireclay. † S.B. = Southern bentonite.

A specially-selected and prepared clay of this type is essential to good results. Since this type of clay is most refractory and gives the highest possible sintering point, it is particularly well-suited to heavy castings and the alloys which are melted at high temperatures.

More of this clay must be used for any given strength than of the high strength clays to be later described. Where very high permeability is required, it would, therefore, be preferable to use a higher strength clay. An exception to this would be the case of the foundry which could not cheaply secure a base sand of the exact fineness required. In such case, the greater volume of this type of clay which would be used would tend to smooth up the surface of a coarser sand giving the finish required.

The kaolinite clays give moderate green strength; moderate dry strength; good flowability; the highest sintering point and lowest contraction at high temperatures of any type of clay. They are also the lowest in cost and have the highest durability.

Montmorillonite Clays

The montmorillonite clays used for bonding in the United States are the Western bentonites

(*Continued on page* 41.)

Moulding Steam Valve Lids for Marine Service*

By FRANK HUDSON

For many years, cast non-ferrous alloys have been widely used on board ship for lids in boiler stop and manœuvring valves. The lid, in a marine valve, is that disc-shaped casting attached to the operating spindle which forms the valve component controlling the flow of steam between boiler and turbine. For this important duty it is obvious that the alloy employed should possess certain properties at elevated temperatures in order to withstand the effects of superheated steam, and castings made from it must be perfectly sound in every way. The necessary service conditions are being met by the use of nickel alloys of one kind or another, the melting of which is not unduly difficult, providing a good furnace is available and full use made of correct melting technique, embodying those principles which have received considerable mention in technical literature during the past few years, namely, the need of an oxidation followed by adequate deoxidation treatment. The supply of good metal, however, constitutes only one problem out of many in the production of sound castings and no one will deny that moulding methods introduce a problem of equal, if not greater, importance in obtaining practical results. This is particularly true in connection with the type of casting under review, as not only is very little published information available on moulding methods, but the need of such is emphasised by the variety of awkward designs in service. Consideration of moulding methods known to give good results will obviously, therefore, be of considerable value to many non-ferrous founders at the present time in facilitating production of a type of casting playing an active part in the national effort.

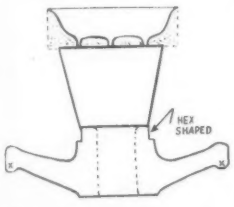

FIG. 1.—LARGE BOILER STOP VALVE LID.

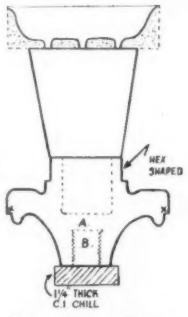

FIG. 2. — LARGE MANŒUVRING VALVE LID.

PRELIMINARY CONSIDERATIONS

Machining and Contraction Allowance

Before describing moulding methods in detail there are one or two preliminary factors worthy of consideration. In the first place, adequate, but not excessive, machining allowances should be made on patterns. As a general rule, $\frac{3}{16}$ to $\frac{1}{4}$ in. on the seat, and $\frac{1}{8}$ to $\frac{3}{16}$ in. per side on pintle, boss and other machined diameters will be sufficient, and wherever possible the seat should be cast down, as any entrapped dirt, slag or sand, however small, on this surface will lead to rejection. The main body of the valve lid should be cast as near to size as possible. The need of greater machining allowances than those stated above indicates something wrong elsewhere, such as gassy or sluggish metal, too low a pouring temperature, poor sand or impermeable mould, incorrect method of running, etc., and an attempt should be made to find out the cause of the trouble rather than to add extra machining and hope for the best. A contraction allowance of $\frac{1}{16}$ to $\frac{1}{8}$ in. per ft. should be allowed on patterns, according to the type of alloy employed.

Pouring Temperature

Pouring temperature for all the nickel alloys used for valve lids is high, being between 1,450 and 1,550 deg. C., according to the composition employed. Unlike gunmetal, however, there is a wide latitude in this direction, and the relation between pouring temperature and casting section is not critical. Every endeavour should be made to pour as hot as possible. The temperature range required is outside the scope of the most suitable foundry type of immersion pyrometer, but a very good guide can be obtained by testing the metal with a $\frac{1}{4}$ in. mild steel bar. If the molten metal just melts the end of this bar, bringing it to a point, it can be assumed that the temperature is around 1,500 to 1,550 deg. C. If the bar does not quite melt, but evolves sparks, then the temperature is in the lower range of 1,450 to 1,500 deg. C. No metal of the types mentioned should be poured into castings lower than 1,450 deg. C.

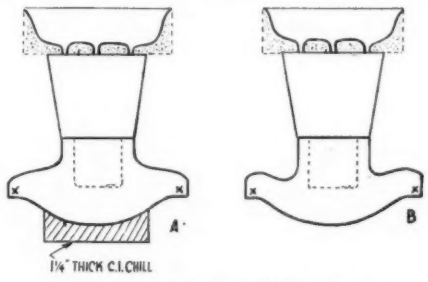

FIG. 3.—BOILER STOP VALVE LIDS.

Moulding Sands

In view of the high pouring temperatures entailed, care must be taken to ensure fairly refractory and permeable moulds. The best results are obtained by the use of dry sand moulds, but green sand can be utilised for small castings if necessary. The majority of natural moulding sands in brassfoundry use, such as Mansfield, Bromsgrove, Belfast, Erith, etc., by themselves are neither refractory nor permeable enough to give the best results, but it by no means follows that they cannot be employed. Satisfactory results can be obtained by ensuring dry-sand moulds made from the above are well wire vented, thoroughly dried, and have their surfaces protected with a good plumbago wash. The latter should be made from the highest grade plumbago bonded with the necessary amount of china clay and water to which a small amount of core gum, dextrine, molasses or wood extract has been added. Just enough of the latter should be used to prevent the dried wash coming away on the fingers when rubbed. Blacking, boulder or common red clay should on no account be employed as alternative constituents, as they lower the refractoriness of such a protective wash. Furthermore, the addition of the organic binder should not be omitted, as this also materially improves refractoriness. The best dry sand for the job is, however, one of the more open mixtures as used for the production of iron castings made from naturally bonded or synthetic sand having an A.F.A. permeability number of not less than 80 with a dried compression strength of not less than 50 lbs. per sq. in. Good results can also be obtained by making the mould in oil sand using four parts of sea sand plus one part of red sand as a base.

For the production of the smaller valve lids in green sand the usual finely textured brassfoundry sands are not satisfactory unless they are opened up with sharp or sea sand and incorporate an addition of around 5 per cent. plumbago or a good grade of blacking in the facing to improve refractoriness. Good results are again obtained by the use of an open iron-foundry type of green sand containing coal dust, but the latter ingredient should not be added to the more common brassfoundry green sands as their permeability as a rule will not take care of the additional gas evolved at the high casting temperatures entailed. Lightly dusting the mould surface with plumbago and printing back the pattern is a useful precaution where this can be conveniently arranged.

For the production of the majority of the castings under review, cores will not usually be required. Although drawings may outline a design where a simple core could be used, it will be found cheaper and better in the long run to machine from the solid as the introduction of cores invariably prevents progressive solidification being obtained with consequent porosity on the hydraulic test which is on an average around 600 lbs. per sq. in.

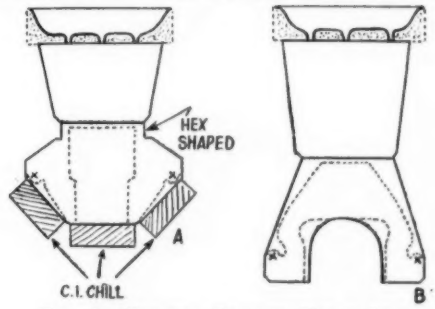

FIG. 4.—GRADUAL OPENING VALVE LIDS.

Valve Lids of Simple Design

Before commencing production, the foundryman should have in his hands a drawing of the finished part showing all machining limits in order to check that allowed on the castings. Furthermore any outside patterns or core-boxes should be carefully examined to ensure that they agree with subsequent remarks relative to the best method of moulding. In many instances, for example, it has been found that patterns and core-boxes are designed in order to facilitate machining operations rather than the production of sound castings. In such cases the foundryman should not commence moulding until satisfactory modifications have been effected. This particularly applies to the provision of core-boxes, the use of which has often to be omitted if the best results are to be obtained.

Fig. 1 illustrates a common and fairly simple design of lid for the larger type of boiler stop valves. Such castings will have overall diameters between 10 to 12 in., with a 4-in. diameter centre boss bored out to $1\frac{1}{8}$ in. dia., and a body section tapering from $1\frac{1}{4}$ in. down to $\frac{7}{8}$ in. adjacent to the seat portion. The stresses these lids have to withstand are often very high, and the importance of obtaining castings of the best quality cannot be too strongly emphasised. No attempt should be made to core out the hole through the centre boss, as this may interfere with the proper feeding of the casting at the junction of the body with the boss, a point where maximum solidity and strength is most needed.

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* Presented at the 38th Annual Conference of the Institute of British Foundrymen, held at Manchester on July 12.

Moulding Steam Valve Lids for Marine Service

Very satisfactory results have been obtained in practice by moulding the seat face down in dry-sand and casting the boss solid, as shown in Fig. 1. A large tapered riser is attached for feeding purposes, and the casting is poured through this riser from a runner bush by a number of $\frac{1}{8}$ in jets, arranged circumferentially so that the metal streams do not strike the mould wall. The height of the riser should be greater than the depth of the boss underneath. Direct pouring into the feeding head is the only way of ensuring the hottest metal at this point, and the use of a pouring bush with jet runners minimises the ingress of slag and also has the additional advantage of acting as a "hot-top" which materially assists in keeping the metal in the riser fluid until the casting has solidified.

FIG. 5.—METHOD OF MOULDING BAR FOR MAKING VERY SMALL LIDS (1-IN. BORE VALVE).

There is, of course, no need to allow the runner bush to retain metal, and pouring can be stopped before the feeding head is full so that the runner bush empties itself into the casting.

Figs. 2 and 3 illustrate a smaller type of lid castings for boiler stop and manœuvring valves. The moulding methods employed in principle are similar to those already described, namely, to cast solid and pour direct through a feeding head, with the exception that recourse should be made to the use of chills in order to assist progressive solidification. For example, in the design shown in Fig. 2, there is some doubt as to whether the head will feed the entire depth of the long centre boss, and the use of an external base chill is indicated. An internal chill, made from a steel bar, acting as a core for the threaded section B (Fig. 2) would be

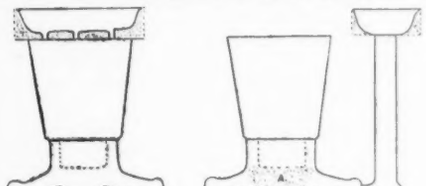

FIG. 6.—HEAVY LIDS (PINTLE TYPE).

still more effective, and if necessary this can remain in the casting and be removed in subsequent machining operations. In the case of domed type lids as outlined at A, in Fig. 3, the section of the casting at the centre is much too heavy in relation to the diameter of the boss to obtain satisfactory results by top feeding alone, and progressive solidification should be again arranged with the assistance of chills or carborundum sand.[1] It is interesting to note that the use of the latter is steadily increasing, and quite a few foundries are finding it a more convenient substitute for chills in the production of pressure castings. If design can be modified to give a more even section, as shown at B (Fig. 3), the use of chills, etc., obviously becomes unnecessary.

Fig. 4 outlines the method of moulding small valve lids of somewhat different design as required for certain types of control valves. The main point to note in both the examples given is the fairly wide pattern modifications entailed over the finished machined product. It will be observed that in the design shown at A the pattern has been altered to facilitate the use of chill segments, whilst the core has been omitted. In the case of example B, there is little alternative

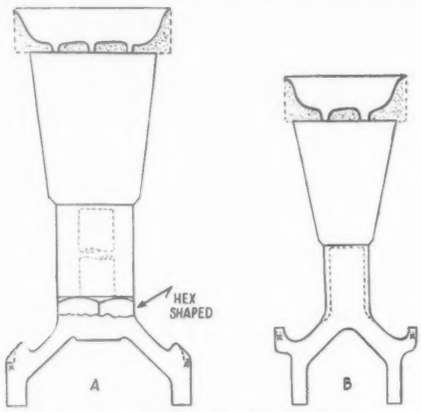

FIG. 7.—LIGHT LIDS (PINTLE TYPE).

but to cast the valve with the seat up, so that the heavier section can be directly fed by the head. In this instance there is an obvious advantage in having the pattern form its own core and, due to the modifications made in the seat area (x), little trouble need be anticipated regarding the possibility of dirt, etc., being trapped at this point. It might be noted that the design of the feeding head has been modified in Fig. 4, over the examples previously given, to embrace a sudden thickening as it leaves the

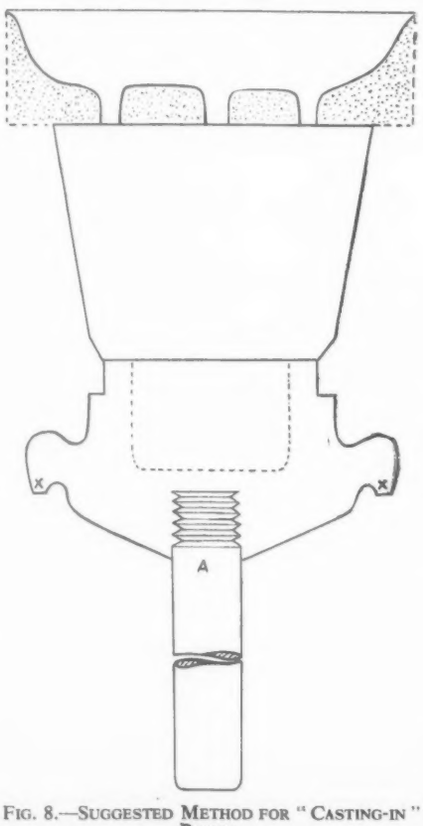

FIG. 8.—SUGGESTED METHOD FOR "CASTING-IN" PINTLE.

casting instead of a gradual taper. There is no doubt that this materially improves feeding action and also provides a guide for cutting off operations in the fettling or machine shop.

In the manufacture of very small lids, say, for 1-in. bore valves, there is little advantage to be gained in making individual castings. The most convenient method is to machine from sand cast bars moulded vertically, as shown in Fig. 5. Chill casting is not recommended, due to the tendency towards centre porosity, and even with sand cast bars care must be taken to ensure that the length of the bar is not too long, otherwise trouble of a similar kind will arise. Normally a bar 6 to 7 in. long, with a head of similar length, is about the maximum which can be employed in conjunction with any guarantee of soundness.

Valve Lids of More Difficult Design

All the lid designs so far dealt with have been free from pintles, and founding difficulties increase when this fitment is incorporated as an integral part of the casting. Fig. 6 illustrates a typical pintle type valve lid, and provides an interesting comparison of good and bad mould-

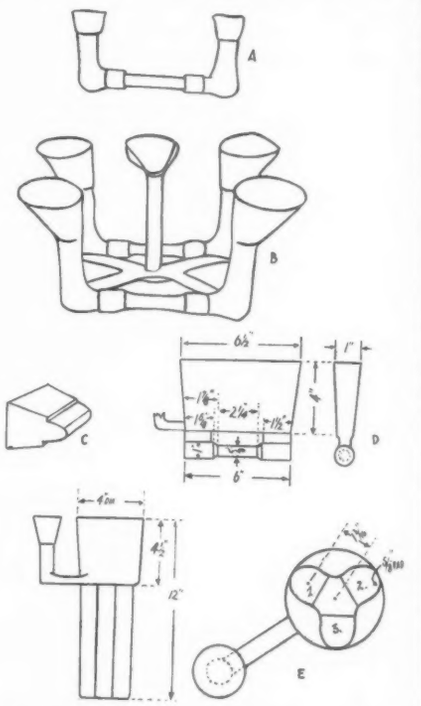

FIG. 9.—MOULDING METHODS FOR TEST-BARS.

ing methods. If the casting is poured as shown at B (Fig. 6), *i.e.*, with a heavy runner on the seat portion, porosity will invariably be found in the centre of the lid at A, even when ample feeding heads are employed. This is due to the fact that, when pouring is completed, the metal at this point is hotter than that in the head, which consequently solidifies before fully feeding the central portion of the castings. The tendency to porosity is further aggravated by the use of a feeding head having an open top and by the extra metal sometimes allowed on a line xx, where the pintle joins the valve body. By adopting method A (Fig. 6) solidity and pressure tightness are ensured.

The latter method works extremely well when the pintle is not too long and when it is attached to a fairly heavy body section. Unfortunately, certain designs of lids exist in which most of the body is of lighter section than the pintle, as outlined in Fig. 7, and it becomes necessary to cast the pintle up in order to get the centre of the casting properly fed. The matter is further complicated by the fact that the valve seat is

Moulding Steam Valve Lids for Marine Service

nearly always on the pintle side, and this must be cast up as well. Fortunately, by exercising a little foresight in slightly modifying the design at this point, as shown in A (Fig. 7), or increasing the machining allowance to about ¼ in., as in B (Fig. 7), any trouble due to dirty seats can be eliminated. The business of getting the pintle and central body section sound is not so easy a matter. In the design shown at A in Fig. 7, incorporating a relatively light pintle and body section attached to a heavy hexagonal shaped centre, it is necessary to increase the diameter of the pintle to equal that of the centre section and subsequently machine the pintle down to size. In castings having no heavy central portion, as illustrated at B (Fig. 7), the pintle need only be thickened enough to ensure progressive solidification. In any case of doubt, however, one should err on the safe side by over-thickening, as on no account should the pintle, when cast up, be allowed to solidify before the body section below.

There are a few designs of lids in existence incorporating a very long pintle where doubt will exist as to whether any method of moulding will produce a satisfactory casting. In such cases it is worth while taking the matter up with the designer as to whether the pintle cannot be made from wrought bar, and subsequently fitted by mechanical means, or cast into the lid in the foundry. In the past there seems to have been very little effort made to "cast-in" pintles, but it should be quite a practical operation providing the body section is heavy enough to ensure the passage of enough metal to effect welding of the pintle with the body. The pintle (A, Fig. 8) can be made from Monel bar, and the end going into the casting should be machined with a series of deep knife-edged parallel grooves to facilitate its union with the molten metal in a similar manner to that employed for a certain type of chaplet, as shown in Fig. 8. The high pouring temperatures employed for the type of castings under review should promote satisfactory fusion, but if any difficulty is experienced recourse could be made to coating the grooved end of the pintle section with pure tin. In many designs of lids the attachment of pintles by a casting-in operation will also materially simplify moulding methods and assist the production of sound castings by their acting as an internal chill.

Test-Bars

The methods outlined in this Paper for moulding valve lids do not readily lend themselves to the production of "cast-on" test-bars, and the supply of separately cast bars should be adopted. Whilst some controversy may arise on this latter point in connection with specification requirements, certain facts stand out very clearly in defence of this argument. In the first place the foundrymen's primary consideration is to produce a sound casting, and this is seriously jeopardised by enforcing the use of "cast-on" bars, particularly in view of the type of alloy employed and the size and design of casting being made. Secondly, all valve lids are invariably subjected to a hydraulic test of at least double their normal working pressure, which in conjunction with an indication of metal quality as provided by a separately cast test-bar, should be amply sufficient to differentiate between suitable and unsuitable material.

Fig. 9 illustrates various moulding methods which can be adopted for the production of test bars required in conjunction with valve lids. The I.B.F. bar, as shown at A, recommended for gunmetal castings, is not altogether satisfactory for nickel alloys, as there is a tendency for the bars to break at the shoulder and give erratic results on test. This is caused through the presence of slight porosity at the end of the bar nearest the riser brought about by inadequate feeding due to the colder metal at this point, and also probably due to strains arising through restricted contraction.

The modified method of moulding the I.B.F. bar outlined at B undoubtedly improves feeding by delivering hot metal to both ends of the test-bar, but contraction strains and cracks can still arise unless the sand between the risers is eased soon after pouring. If this operation is not carefully done there is still the danger of the test-bar being damaged through rough handling, and probably the simplest way of producing consistently sound bars is to adopt either the wedge or clover leaf[2] type of pattern, as shown at C and E. Furthermore, these two methods produce test-bars moulded in a similar manner to the actual lid castings, and the test figures attained are therefore more nearly representative of the metal quality in the actual casting. Some foundrymen may grumble about the increased machining entailed in removing the head from the best bar portion in the latter types, but this becomes a relatively simple matter if a high speed slitting wheel or one of the latest types of fast metal cutting circular saws is available. Admittedly, without some such assistance the removal of the test-bar portion is a tedious operation, and matters can be facilitated by adopting the moulding method illustrated at D in Fig. 9. This method is widely used in the United States, and providing the test-bars are kept short good results are obtained. The mould is gated at the base of the head portion as shown and two bars poured from a common runner.

One last thought in conclusion. Remember that steam valve lids for marine service are required to stand up to arduous conditions these days, and only the best is good enough. If a casting is not wholly satisfactory, then scrap it without compunction, and on no account attempt to patch it up by welding, nor disguise its solidity by peening or any other means.

REFERENCES.

[1] Metal Industry, May 21, 1937, page 573.
[2] Proc. I. Brit. F., vol. XXXIII, 1939–40, page 61.

American Synthetic Sand Practice

(*Continued from page* 38.)

produced principally in Wyoming and the Southern bentonites produced principally in Mississippi. Both types of clays are available and carried in stock in the United Kingdom. These clays have the finest grain size of any bonding clays. They develop double the green strength of the best kaolinites. The Western bentonites swell when placed in water while the Southern bentonites are non-swelling. The bentonites give the highest permeability of any clays and the highest or lowest dry and hot strengths depending upon the type selected.

The most important recent American research work on sands has been on hot strengths and the most important recent development in practice has been the use of combinations of clays instead of a single clay.

Tables II, III, IV, V and VI show hot strength behaviour and will be discussed briefly since this information is important in choosing the single clay or the combination of clays to be used. Table II shows a rather startling increase in hot strength with only slight increases in clay and water content. This indicates that kaolinite clays have adequate hot strength for any job when properly handled. It may also indicate the source of some cracked castings in the malleable industry since an overtempered batch of sand has far higher hot strength than the same sand properly tempered.

Table III shows the gradual increase in hot strength from Southern bentonite, through combinations, to Western bentonite. A foundry might have washes and cuts due to the low hot strength of Southern bentonite or difficult shake out, lumpy sand and cracked castings due to the high hot strength of Western bentonite. A combination of the two may be made to yield the exact strength required.

Table IV shows the same progression from low to high hot strength when mixing Southern bentonite and Ohio fire clay. When difficulty is experienced with either low or high hot strength from a single bond, certainly it is only common sense to use a combination that will give the hot strength required to stop cutting and washing and no more. This extends sand control into a hitherto untouched and frequently troublesome field.

Table V shows that combinations of Ohio fire clay and Western bentonite, instead of giving hot strengths intermediate to the bonds used, gave a peak strength more than twice as high as either component. This could hardly have been predicted from low temperature, dry-strength testing. Such combinations should have excellent application for heavy iron or steel castings.

Table VI shows that additions of cereal binder (cornflour), pitch and rosin sharply increase the dry strength of Southern bentonite, although the increase in hot strength is such as still to provide a highly collapsible sand. Such a sand should be desirable for steel castings which have a tendency to crack. It is interesting to note that the addition of cereal binder to Western bentonite did not appreciably increase dry strength, and caused a sharp decrease in hot strength. This indicates that steelfoundrymen who have used such combination for increased strength have not benefited much in that respect, but have actually provided a more collapsible sand.

(*To be continued.*)

Gates and Risers

(*Concluded from page* 42.)

In addition to feeding castings, gates can be made to perform mechanical skimming effects. Dirt and drosses will separate from the metal wherever it changes its course of direction or drops its velocity within the mould. Gates used to accomplish this effect are generally known as strainer, choke, skim or whirl gates.

Fig. 33 illustrates a pouring box with pencil gates, and is recommended for all top pouring, whilst Fig 34 is a choke gate used on most work to hold back dross and to keep the sprue full.

Fig. 35 shows a skim core, novel in design, but seldom used, although efficient when utilised as a choke. Fig. 36 is a strainer core placed in the gate and used by many foundrymen.

Fig. 37 shows the whirl gate with the dross thrown out at A, and Fig. 38 shows a horn gate which has many advantages on such work as gears, propellers, etc.

There is no limit to the material which can be written about gates and risers, and this Paper is only meant to lay down the fundamentals for a better understanding of the directional solidification that is required for the making of sound castings in tin bronzes and red brasses.

U.S. Malleable Castings Output

Production of malleable iron castings in the United States in the first four months of this year totalled 274,451 tons, compared with 175,945 tons in the like 1940 period. Total orders booked in the four months were 328,188 tons, against 146,359 tons in the same 1940 months.

Gates and Risers*

By W. B. GEORGE (R. Lavin & Sons, Inc., Chicago)

In order to understand the technique required in the proper placing of gates and risers, it is necessary to first obtain a clear picture of just what is taking place within the casting.

The first particles of metal to solidify within the mould are in crystal form, as shown in Fig. 1, which in the progress of solidification arrange themselves in dendritic patterns, illustrated in Fig. 2. In properly fed castings these patterns are completed into grains throughout the entire mass and bound together, as shown in Fig. 3. When castings are improperly fed, many grains

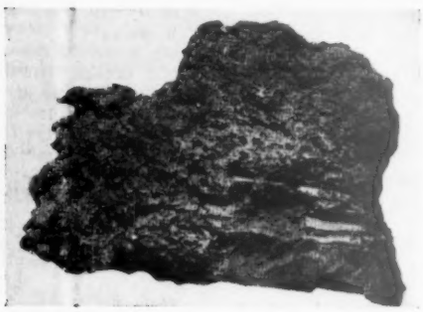

FIG. 5.—DENDRITIC STRUCTURE DUE TO IMPROPER FEEDING. SPECIMEN IS RED BRASS AND WAS CAST AS SHOWN IN FIG. 22, SECTION A.

are not completed and porous spots are found within the castings. This is illustrated with Figs. 2 to 8. Should the section be of large size, it is found that this dendritic structure has collapsed, leaving a shrink hole, as shown at A in Figs. 13, 21 and 22.

In the building of a sound house, it is necessary to use solid material. It is the same in the making of a casting—it is imperative to have grain completion or dendritic structures result in some cases, and shrink holes in others,

FIG. 6.—GENERAL ARRANGEMENT OF COLUMNAR GRAINS BROUGHT OUT BY HOT FRACTURE. SPECIMEN IS OF A LOW-GRADE BRASS.

which correspond to unsound material in the building.

In order to bring about a sound grain structure throughout the entire casting, the metal must be solidified directionally from the farthest point of the mould, toward the gate or riser. This directional solidification is like laying the bricks from the foundation to the roof. Each brick or grain is fitted properly to support the following one.

These grains, when properly fed, adjust themselves to fit each other, as well as the contour of the casting.

There are two general types of grains, one being columnar and the other equiaxial; Fig. 4A illustrates columnar grains; Fig. 4B illustrates equiaxial; Fig. 4C illustrates columnar and equiaxial grains, both in the same casting.

As a rule, columnar grains predominate in copper-tin and red brass alloys, while equiaxial grains predominate in the manganese and aluminium bronzes. This Paper, however, has no bearing on manganese or aluminium bronze alloys.

The size of the grain is governed by the cooling rate. Slower cooling develops a larger grain. Since large grain sizes are not desired, it becomes necessary to pour metal as cold as possible and still feed the casting. In practice, this temperature varies from 982 deg. to 1,260 deg. C., depending upon the size and shape of the casting. Test bars are generally poured at 1,175 deg. C.

Fig. 9 illustrates directional solidification in its most ideal form. There is about 165 deg. C. drop in temperature from the heavy to the light end in a wedge 12 by $\frac{1}{4}$ by $\frac{1}{8}$ in.

Fig. 10 illustrates a disc, for instance, 12 in. in diameter and 1 in. thick. If the top and bottom surfaces should be machined and liquid or air pressure should be applied at the centre, it would leak in most cases. Upon fracturing, there would be found a coarse dendritic structure at A, minus the necessary grain boundaries. On further examination of the structure, it is found that solidification started from the surfaces B, shutting off the effect of the risers. In order to obtain a sound casting of this type, it is imperative to start solidification in the centre, and the risers should feed toward it. This may be accomplished by the use of a chill shown as X in Fig. 11, or lightening of the centre, as described in Fig. 12.

Fig. 13 illustrates the use of a riser upon a boss or hub of a casting where the neck is too small. As the neck freezes before the boss or hub, the result is an internal shrink at A.

Fig. 14 illustrates the same hub or boss with sufficient riser which will not freeze off, but which will keep up the directional flow of liquid metal until the mass of the casting has become solidified.

Fig. 15 shows the use of the horn gate. Fig. 16 illustrates a pouring box with "pencil gates."

It should always be borne in mind that the hottest metal must exist in the riser. In order to accomplish this, it becomes necessary either to gate into the riser or fill it with hot metal after the casting is covered.

Fig. 17 shows a large casting poured from the bottom with an internal shrink due to cold metal being forced to the top.

Fig. 18 shows the same casting with risers too far apart, and porous spots at B.

Fig. 19 shows design for a ring riser with side gates for this class of work.

Fig. 20 illustrates an ideal method for the pouring of large castings. By this method the metal is ladled into the pouring box, which has a number of small pencil gates. These pencil gates relieve the strain, hold back the dross, and govern the rate of pour.

Fig. 21 illustrates bottom gating of a solid bar, say, for example, 6 in. in dia. and 16 in. long. The result is shrinkage in the side A and centre B.

Fig. 22 shows the same bar with improper riser, resulting in internal shrinkage at A.

Fig. 23 shows this casting with top riser and side gate, which is satisfactory.

Fig. 24 shows ideal method to cast large, solid bars. The pouring box with the pencil gates can be developed to govern rate of solidification.

Many times castings are seen which are gated as shown in Fig. 25. This is a poor method since the coldest metal remains in the riser. The result is a porous spot at A. Fig. 26 is the preferred method, since the hot metal is where it is needed. In Fig. 27 is shown the result when hot metal does not reach the riser farthest away from the gate. The defect is porosity shown at A. Fig. 28 shows the proper gate with hot metal going into all risers.

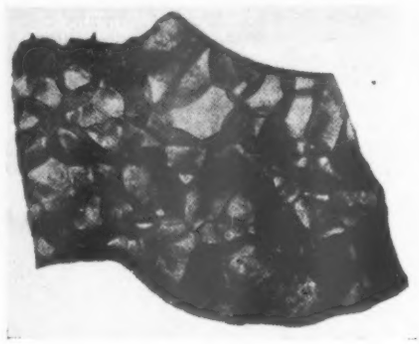

FIG. 7.—ARRANGEMENT OF EQUIAXIAL GRAINS BROUGHT OUT BY HOT FRACTURE. SPECIMEN IS OF ALUMINIUM BRONZE.

In making many classes of work, it often becomes necessary to gate on the thin wall of the casting. This should be followed out with consideration for the wall thickness; a little forethought here will save many castings.

Fig. 29 illustrates a gate that is too large for the wall to which it is attached, with the result of an internal shrink at A.

Fig. 30 illustrates a draw B on the internal wall of the casting from a gate that is too small, and Fig. 31 illustrates a draw on the external

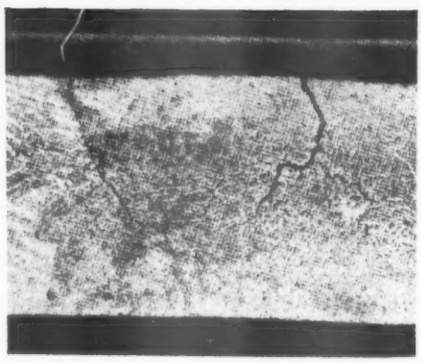

FIG. 8.—DENDRITIC STRUCTURE OF THE PART OF A PRESSURE CASTING THAT LEAKED, SHOWING INCOMPLETED GRAINS. MATERIAL IS COPPER-TIN BRONZE.

surface of the casting due to lack of a proper fillet.

Gates on thin wall castings must be designed so that they are part of the casting itself, and must be neither larger nor smaller than the wall to which they attach. The fillet radius between the gate and the casting should be one-half of the wall thickness.

Fig. 32 illustrates the proper proportion.

(*Concluded on page* 41.)

* "Iron Age" Report of a Paper presented to the Indianapolis Chapter of the American Foundrymen's Association.

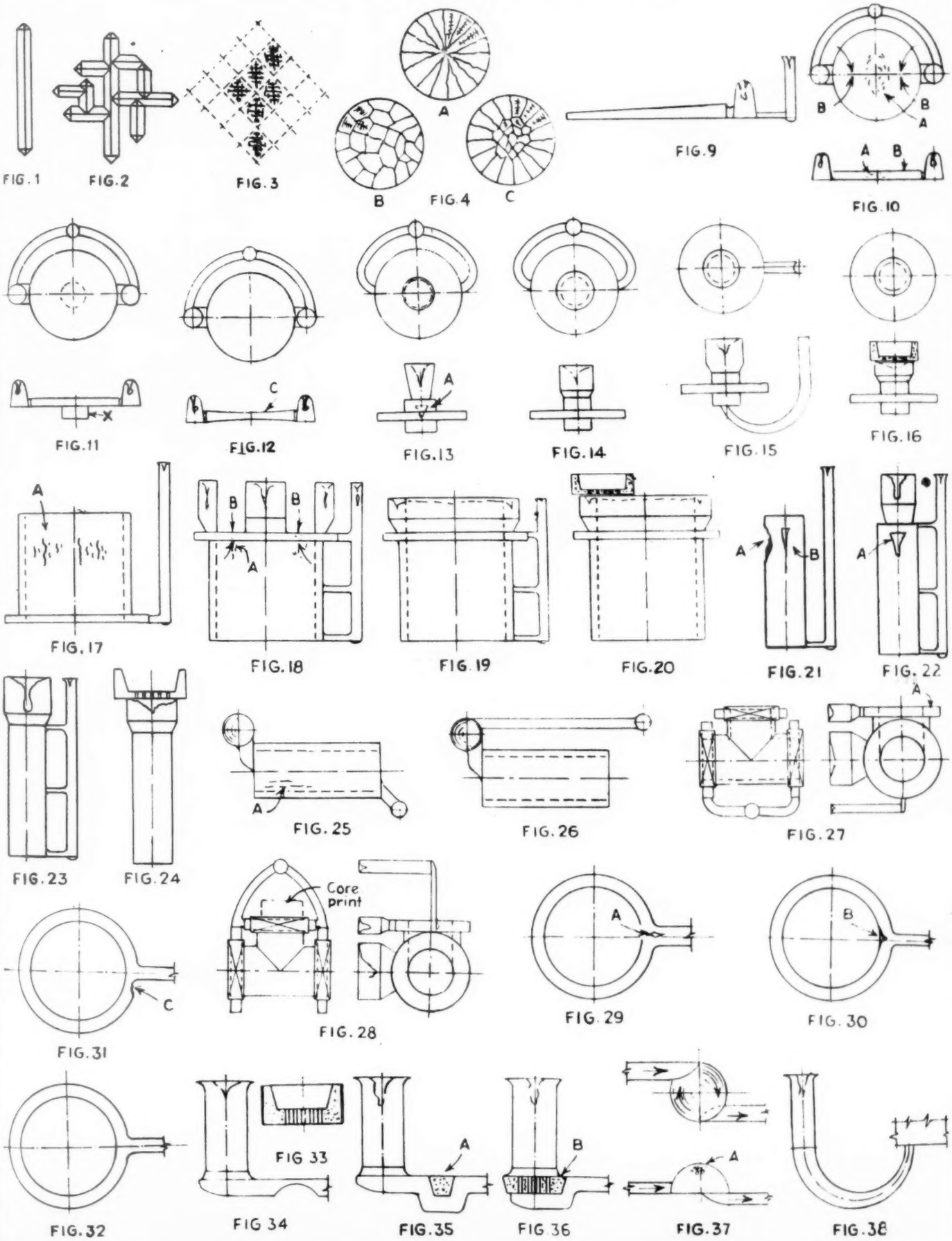
FIG. 1
FIG. 2
FIG. 3
A
B
C
FIG. 4
FIG. 9
B
B
A
A
B
FIG. 10
X
FIG. 11
C
FIG. 12
A
FIG. 13
FIG. 14
FIG. 15
FIG. 16
A
FIG. 17
B
B
A
FIG. 18
FIG. 19
FIG. 20
A
B
FIG. 21
A
FIG. 22
FIG. 23
FIG. 24
A
FIG. 25
FIG. 26
A
FIG. 27
Core print
FIG. 28
A
FIG. 29
B
FIG. 30
C
FIG. 31
FIG. 32
FIG 33
FIG 34
A
FIG. 35
B
FIG 36
A
FIG. 37
FIG. 38

Some Factors Affecting the Resistance of Cast Iron to Deflection under Load at High Temperatures

By L. W. BOLTON, A.M.I.Mech.E. (British Cast Iron Research Association, Birmingham)

(*Concluded from page* 24.)

Rigidity of Carbon Steel at 850 deg. C.

Three plain carbon steels, forming Series E, were tested in order to obtain a comparison between their resistance to deflection at 850 deg. C. and that of cast iron. They had typical low, medium and high carbon contents, the analyses being given in Table IV. The test-bars were machined from normalised steel rod, 0.75 in. in dia. The deflections of these bars are shown in Fig. 8. It will be noted that the 0.02 per cent. carbon steel gave a deflection curve somewhat different from those obtained on the cast irons. Deflection is at first fairly rapid and then slows up, finally becoming rapid again. A possible explanation for this was found when a section from the parallel part of the bar after test was examined under the microscope. This showed that crystal growth had taken place to a very considerable extent. It appears probable that as the crystals became larger, the resistance of the bar to deflection at high temperatures was increased. This conclusion is supported by the results obtained on the 0.84 per cent. carbon steel; little grain growth occurred and the deflection curve of this bar is smooth. The bar scaled rapidly and the rapid deflection at the end of the test was no doubt due to wastage of the specimen. Figs. 29 to 34 show the structures of the three bars before and after the test, the latter being taken from the stressed portion of the specimens. Grain growth has taken place to a considerable extent in the 0.02 per cent. carbon steel bar and to a smaller extent in the 0.46 per cent. carbon steel bar. There is little change in the structure of the 0.84 per cent. carbon steel after the test.

TABLE IV.—*Compositions of Steel Bars, Series* E (*Increasing C*).

No.	C	Si	Mn	S	P
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
15	0.02	0.002	0.40	0.062	0.061
16	0.46	0.062	0.64	0.034	0.008
17	0.84	0.164	0.31	0.035	0.025

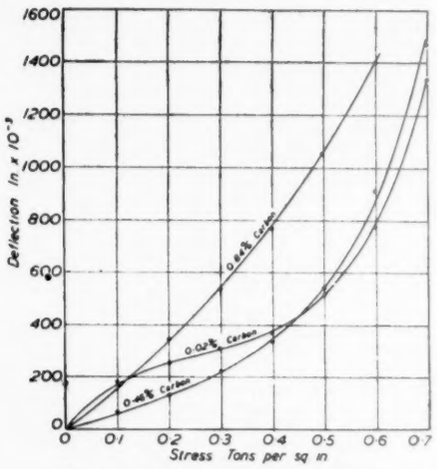

FIG. 5.—DEFLECTION OF STEEL BARS, SERIES *E*, AT 850 DEG. C.

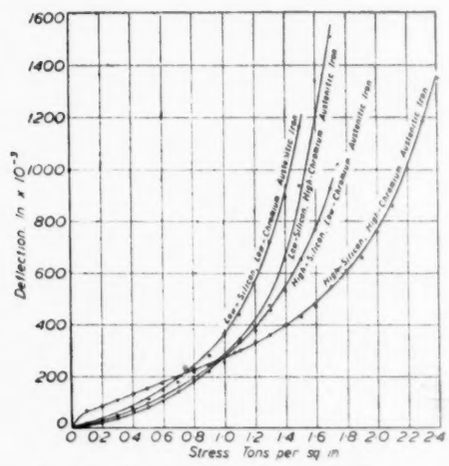
Deflection In x 10⁻³
Stress Tons per sq in
Low Silicon, Low Chromium Austenitic Iron
Low Silicon, High Chromium Austenitic Iron
High Silicon, Low Chromium Austenitic Iron
High Silicon, High Chromium Austenitic Iron

FIG. 9.—DEFLECTION OF SERIES *F* BARS AT 850 DEG. C.

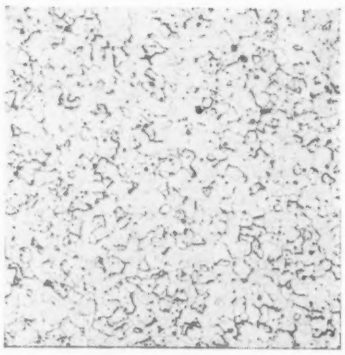

FIG. 29.—AS RECEIVED.

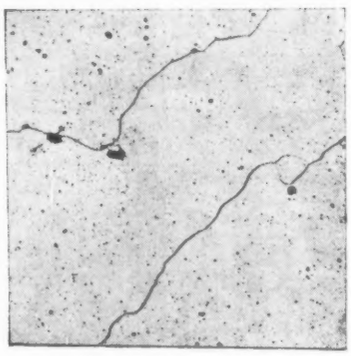

FIG. 30.—AFTER TEST.

Figs. 29 and 30.—Carbon, 0.02 per cent.

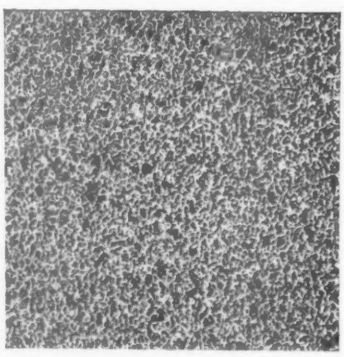

FIG. 31.—AS RECEIVED.

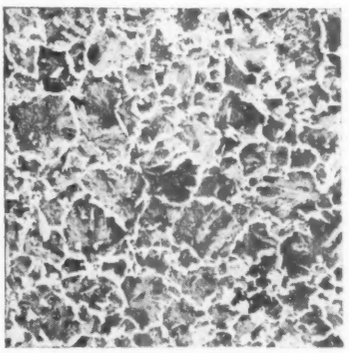

FIG. 32.—AFTER TEST.

Figs. 31 and 32.—Carbon, 0.46 per cent.

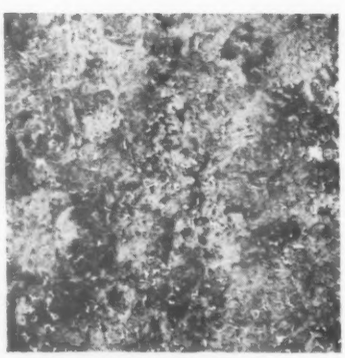

FIG. 33.—AS RECEIVED.

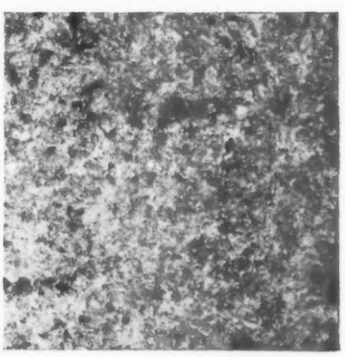

FIG. 34.—AFTER TEST.

Figs. 33 and 34.—Carbon, 0.84 per cent.

Figs. 29 to 34.—Steel bars, Series *E*. Etched in picric acid. Mag. 75.

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When these results are compared with those for the cast irons, it is found that the high-carbon (0.8 per cent.) steel deflected considerably more than any of the cast irons tested, with the exception of those with very coarse graphite structures (large-diameter bars). The medium-carbon (0.4 per cent.) steel has a resistance to deflection comparable with that of a cast iron containing 5.75 per cent. of Si (0.65-in. dia. bar).

Rigidity of Austenitic Heat-Resisting Cast Irons at 850 deg. C.

The most important of the recently developed heat-resisting cast irons are the highly alloyed austenitic irons known as Ni-Resist and Nicrosilal. The former contains nickel, copper and chromium, and the latter nickel, silicon and chromium. Both types of iron are made in a range of compositions to suit various conditions of service. Increasing the chromium content usually results in an increased resistance to scaling and growth, but high chromium renders the metal hard and practically unmachinable in the as-cast state. Two irons of each type, with high and low chromium contents, were tested, the compositions for this Series (F) being as given in Table V.

All the bars were cast in green-sand moulds from metal melted in a coke-fired crucible furnace. The metal was produced from charges consisting of Swedish white iron (3.8 per cent. total carbon), ferro-silicon (40 per cent. Si), Armco iron and ferro-chromium (70 per cent. Cr, 1.5 per cent. C), with small additions of ferro-phosphorus and ferro-manganese. Nickel was added as nickel F shot, and copper scrap was used for additions of this element. In each case the metal was melted down and superheated for 15 min. before pouring. The as-cast size of the bars was 0.75 in. in dia.

The resistance of these irons to deflection under load at high temperatures is shown in Fig. 9. The higher-chromium bars of each type are more rigid than those lower in Cr. The higher-silicon material offers a greater resistance to deflection than the lower-silicon bars, in both the high- and low-chromium compositions. The as-cast structure of these bars is shown in Figs. 35 to 38. The rapid deflection of the high-chromium high-silicon iron in the early stages of the test may be due to a change in structure taking place. It will be seen from the microstructure, Fig. 38, that in the as-cast state the structure is composed of cementite and austenite. Evidence is available that in irons of this composition carbide is deposited from the solid solution in the early stages of heating. It is possible that the resistance of the bar to deflection would be reduced while this structural change was taking place. It would appear that irons of this type should be well annealed at a temperature of 850 to 900 deg. C. before being put into service. These tests show that austenitic high-silicon Ni irons are more rigid at high temperatures than austenitic Cu-Ni irons, and that additions of Cr increase the stiffness of austenitic cast irons at 850 deg. C.

TABLE V.—*Compositions of Alloy Heat-Resisting Irons, Series F.*

No.	T.C.	Si	Mn	S	P	Ni	Cr	Cu
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
18	2.51	1.63	0.53	0.073	0.270	16.40	2.51	7.35
19	1.79	5.90	0.76	0.027	0.033	17.15	1.95	—
20	2.23	2.00	0.54	0.029	0.190	15.74	11.95	7.10
21	2.18	4.91	0.49	0.039	0.031	18.65	7.25	—

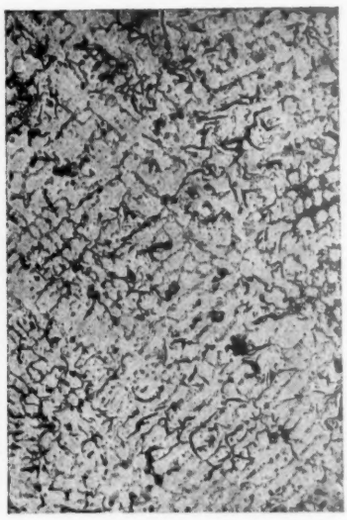

FIG. 35.—CU, 7.35 PER CENT.; NI, 16.40 PER CENT.; CR, 2.51 PER CENT.

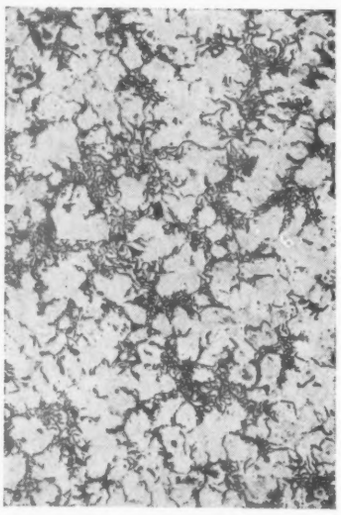

FIG. 36.—SI, 5.90 PER CENT.; NI, 17.15 PER CENT.; CR, 1.95 PER CENT.

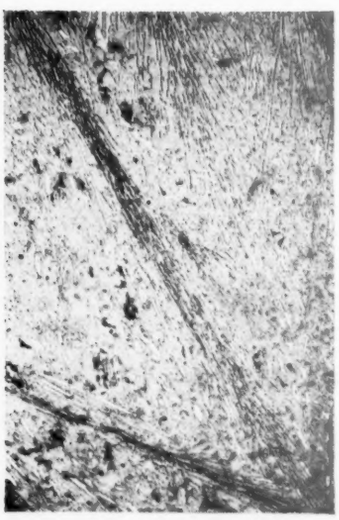

FIG. 37.—CU, 7.10 PER CENT.; NI, 15.74 PER CENT.; CR, 11.95 PER CENT.

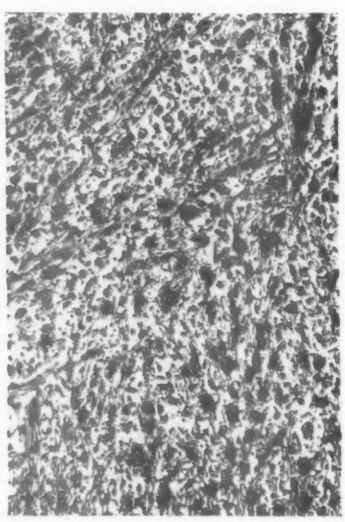

FIG. 38.—SI, 4.91 PER CENT.; NI, 18.65 PER CENT.; CR, 7.25 PER CENT.

Figs. 35 to 38.—Alloy heat-resisting irons, Series *F*. 0.75-in. dia. bars. Etched in 10 per cent. alcoholic HCl (boiling). Mag. 75.

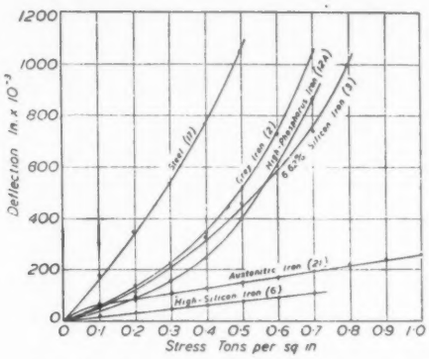

FIG. 10.—DEFLECTION OF CAST IRONS AND STEEL AT 850 DEG. C.

Fig. 10 shows a comparison of the resistance to deflection at 850 deg. C. of a steel, an ordinary good-quality grey cast iron, a high-phosphorus grey iron, a good heat-resisting iron of the Silal type, a high-silicon iron and a highly heat-resistant austenitic iron.

Conclusions

Many factors influence the resistance to deflection of cast irons at elevated temperatures. Normal engineering irons have little resistance to growth and scaling and will, of course, fail from these causes under prolonged heating. High-silicon cast irons of the Silal type were found to have a good measure of stiffness at 850 deg. C. Higher-silicon irons (7 to 9 per cent. Si) have an excellent resistance to scaling and growth, and an increased resistance to deflection. These irons would be expected to have a much longer life than straight grey irons under most conditions of high-temperature service. The tests carried out show that such irons are capable of undergoing considerable deflection at 850 deg. C. without fracture.

The high-silicon acid-resisting type of iron (14 per cent. Si) was found to be very rigid at 850 deg. C. This type of iron is, however, extremely brittle in the cold, and although proved to be relatively ductile at a temperature of 850 deg. C., would possibly crack if subjected to rapid changes in temperature.

(*Continued on page* 48.)

IS YOUR WAR EFFORT BEING HINDERED ?

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Blast-Furnace Problems in the U.S.S.R.

Reviewing blast-furnace research in the U.S.S.R. during the last ten years, in "Metals and Alloys," S. L. CASE, of the Research and Development Division of the Jones & Laughlin Steel Corporation, calls attention to the use of "ferrocoke" and the addition of steam to the blast in Soviet blast-furnace practice.

As a general statement, says the author, the most important problem facing the industry in the U.S.S.R. has been an increase in productivity of the existing plants and design of new and larger plants. It is pointed out that the largest blast furnaces in the world, with a capacity in excess of 1,300 tons daily, are in operation in the U.S.S.R. As one of the steps to increase the productivity of the existing blast-furnace plants, oxygen enrichment is being experimented with on a fairly large scale. With this end in view a pilot blast furnace has been constructed at the Dniepropetrovsk works for experimentation with enriched blast under controlled conditions.

"Ferrocoke"

As another development tending to increase production of blast furnaces at the Stalin Metallurgical Works, so-called "ferrocoke" was tried on a large scale in the manufacture of iron. "Ferrocoke" is the product of an admixture of 10 per cent. flue dust to the coal charge in coke ovens. It is reported that 400,000 tons of "ferrocoke" were thus prepared without introducing any technological difficulties in the operation of the coke ovens, and that the physical quality of the "ferrocoke" was found to be satisfactory for smooth blast-furnace operation. One blast furnace was operated on a 100 per cent. substitution of "ferrocoke" for regular coke, and after a 15-month trial it was claimed that the production capacity of the furnace increased 3.2 per cent., consumption of "ferrocoke" was 17 per cent. lower than that of ordinary coke, and the manufacturing cost of the pig-iron decreased 5.6 per cent.

V. Koloskov has described a method for regulation of blast-furnace operation by means of an automatic flue-dust sampling apparatus, which furnishes a continuous record of the flue dust content in blast-furnace gas in grammes per litre. By means of a nomograph plotted from observational data, it was found possible to vary the coke ratio, pressure and temperature of blast with the result that the yield of iron increased, silicons were more uniform, and "scaffoldings" were eliminated.

Steam Added to the Blast

While the use of dry blast is occupying the attention of American blast-furnacemen, states the author, Russian contemporaries venture in the opposite direction. A. Ryedko describes the operation of a blast furnace on blast containing 5 per cent. steam. The steam was admixed with the air under the checkers of the hot stoves and the temperature of the blast was slightly increased. The experiment resulted in an increase of daily production of 12.6 per cent. (average daily production with air blast 988 tons of iron; average daily production on steam and air, 1,113 tons). This practice is still in use at the Kuznetsk works.

Y. Smolyanitski reports on the use of blast-furnace flue dust in refining pig-iron. The flue dust is added directly into the runner during the casting of the iron. A 4 per cent. addition of flue dust has shown to increase the pig-iron yield 2.5 per cent. and to reduce very appreciably the silicon, manganese, carbon and sulphur contents of the iron. The preliminary refining of the iron was found to increase the production of the open-hearths approximately 15 per cent. It is claimed that the addition of the flue dust does not lower the temperature of the iron.

Die Casting Speeds Up Aircraft Production

Important, highly-stressed aircraft components, the manufacture of which had previously necessitated lengthy and expensive "built-up" constructions, are now being produced virtually in single operations as light alloy gravity die castings. The example illustrated in Fig. 1 is a control member (in a modern high-performance aircraft), which is subjected to rigorous conditions in service for which only a high-strength alloy is suitable.

The material used, NA.226 alloy, has been specially developed for such purposes by the Northern Aluminium Company, Limited. It is a casting alloy of high strength and guaranteed high elongation, and its value is extended by virtue of its suitability for making straightforward castings by the gravity die-casting process. The alloy is produced in conformity with three DTD. specifications, 361, 304 and 298, the production of the component referred to being governed by DTD. 304.

The component, which measures 9½ in. by 5½ in., is cast in gravity dies, the only machining necessary being that required to size the hole in the base. It is thus an admirable example of the simplicity of die-casting methods of production as compared with built-up constructions

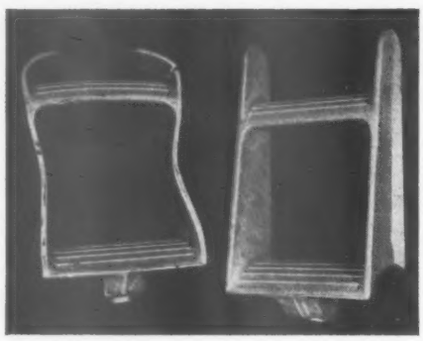

FIG. 1.—DIE-CAST CONTROL MEMBER BEFORE AND AFTER DESTRUCTION TEST.

involving, possibly, flanged and formed sheet, forgings and tube, with the attendant machining, drilling, riveting and welding. Drawing-office work and scheduling are also reduced by the elimination of a number of component parts. The shock resisting properties of the final product are revealed by the following data.

A Drastic Test

In submitting a production casting to the destruction test indicated in Fig. 1, in which a 7-lb. hammer was used, the test was extended until one top lug was fractured completely as shown, and the second lug bent until cracking first appeared. Calculations made on the assumption of ideal bending conditions, *i.e.*, no strain at the neutral axis, and based on measurements of the bend radius and thickness of the casting at the point where fracture commenced, gave an elongation figure of 15 per cent. over the length involved in the bend. These results were confirmed by tensile tests, the elongation values averaging 13 per cent., 14.5 per cent. and 17 per cent. over gauge lengths of 2 in., 1 in. and ½ in. respectively.

The figures reveal the eminent suitability of the material for members likely to be subjected to severe stresses in service, and thoroughly justify the adoption of simply-produced, lightweight die-cast components in place of the frequently heavier, and always more cumbersome and expensive composite assemblies which were formerly considered indispensable for such purposes.

Resistance of Cast Iron

(*Concluded from page 46.*)

At the temperature at which these tests were carried out, additions of phosphorus were found to be beneficial in increasing the resistance of cast iron to deflection; this was particularly so in the case of the higher-silicon irons. It should, however, be noted that the phosphide eutectic melts at a temperature of approximately 960 deg. C., and at temperatures of this order the presence of relatively small quantities of phosphorus is sufficient to cause almost complete loss of mechanical strength.

The austenitic irons Nicrosilal and Ni-Resist were found to have a good resistance to deflection at 850 deg. C. As these irons also have a marked resistance to scaling and growth, they are suitable for use under many conditions of service.

Graphite size has an important influence on resistance to deflection at high temperatures. It would appear necessary that grey cast iron for high-temperature service should have as fine a graphite structure as possible. This may be obtained by relatively rapid cooling of the metal from the molten state, or by the use of a low total-carbon content. The thickness of the casting should be kept to a minimum, as thick sections cool slowly, and this normally yields a coarse graphite structure. Slight differences in graphite size are, however, of less importance than relatively small changes in composition, *e.g.*, in silicon or phosphorus content.

Three plain carbon steels were tested, and it was found that these had less resistance to deflection at 850 deg. C. than many of the cast irons examined.

In using the data obtained from these tests in deciding on the most suitable type of iron for service at high temperatures, conditions of service must be taken into account. If, for example, the service conditions entail heating the casting slowly to a uniform temperature, it is thought that an iron which is highly resistant to deflection will give better service than one which is less resistant. On the other hand, if the service conditions are such that the casting is subjected to steep temperature gradients, then it is possible that some stiffness must be sacrificed, and a less rigid iron will be better able to withstand these conditions. It is known, for example, that the high-silicon cast irons, shown to be very resistant to deflection at high temperatures, are susceptible to cracking under conditions where temperature gradients exist, while hematite irons with a coarse graphite structure give good service under conditions where considerable and rapid changes in temperature occur.

The author wishes to express his thanks to the Council of the Iron and Steel Institute for the award of a grant from the Andrew Carnegie Research Fund, with the aid of which this research was carried out. His thanks are also due to the Director, Mr. J. G. Pearce, and the Council of the British Cast Iron Research Association, in whose laboratories the tests were made, and to Dr. A. L. Norbury for assistance and advice in connection with the work.

Estimating the Length of Material in Any Roll

The "Canadian Mining Journal" gives an easy method for finding the length of any material that comes in rolls—wire cloth, paper, hose, belting, canvas, chains, rope, cables, wire, etc. Measure the full radius of the roll, from the outside of the roll to the inside of the first turn beyond the centre. Express this distance in inches, and then count the number of turns. Multiply the two together and multiply that by 0.2618. The result is the length of the roll in feet. This rule holds true regardless of whether the material is paper, leather, or anything else. The thickness of the material does not make any difference. Even if the roll is so tightly wound that there is no visible hole through it, the rule still holds true; also if it is loosely wound.

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The Week's News in Brief

Trade Talk

SHIPBUILDERS from the Clyde and other areas are to go to Canada to assist in the Dominion's merchant shipbuilding programme.

THE PREMISES of the Scottish Enamelling Company, Limited, and the Larbert Art Metal Company, Limited, were involved in a fire at Larbert on Friday last. Some damage was done.

LOCAL OPPOSITION has been forthcoming to a suggestion to close a sheet and galvanising works in South Wales under the Concentration of Industries Scheme. Efforts are being made to get the proposal reviewed in the national interest. The works employ about 900 men.

BRITAIN HAD REACHED the highest point of production per man in her history, said the Minister of Labour (Mr. Ernest Bevin) in a speech at Manchester last Saturday. He singled out the workers in the shipyards in part illustration, stating that, with fewer yards and therefore fewer men than in the busiest periods of the last war, output was greater by 30 to 40 per cent. Earlier, Mr. Bevin told the Lancashire, Cheshire, and North Wales Federation of Trades Councils that, after questions in the House of Commons about absenteeism and idling in factories, investigation in more than 20 cases had not confirmed the allegations. He also appealed to transport chiefs to improve and speed up workers' travel in the coming winter.

TO AID in the speeding-up of war production, it has been decided to set up a joint advisory committee to the Production Executive, composed of employers' representatives, nominated by the British Employers' Federation and the Federation of British Industries, and workmen's representatives nominated by the T.U.C. General Council. The terms of reference are "to advise the Production Executive on general production difficulties, excluding questions relating to wages and conditions in individual industries normally subject to joint negotiation, and such other matters relating to production as might arise from the proceedings of the Regional Boards or be referred to the committee by the Production Executive." The employers' representatives are:—Lt.-Col. Lord Dudley Gordon, president of the Federation of British Industries and chairman of J. & E. Hall, Limited; Mr. H. F. Brand; Mr. John S. Boyd; Sir Charles Bruce-Gardner, chairman of Armstrong-Whitworth Securities Company, Limited; Mr. Lewis Jones, M.P.; Mr. W. A. Lee (Mining Association); Mr. Guy Locock; Mr. G. S. Maginness, managing director of the Churchill Machine Tool Company, Limited; Mr. A. McKinstry, deputy-chairman and managing director of Babcock & Wilcox, Limited; Sir Alexander Ramsay; Mr. A. J. G. Smout, chairman, delegate board of I.C.I. metals, Limited, and subsidiaries; Sir Jonah Walker-Smith, M.P., and Sir John Forbes-Watson. The workers' representatives are:—Mr. C. H. Bagnall, Sir Walter Citrine, Mr. A. Conley, Mr. A. Deakin, Mr. C. Dukes, Mr. W. Elger, Mr. G. Gibson, Miss F. Hancock, Mr. H. N. Harrison, Mr. M. Hodgson, Mr. J. Kaylor, Mr. P. Paterson, Mr. W. Thomson. The chairman is the chairman of the Production Executive, Mr. Ernest Bevin.

Concentration of the Tinplate Industry

The Minister of Supply has appointed the following as a Committee to consider and report on the application to the tinplate industry of the policy of concentration of industry, having regard to the measure of redundant plant existing in the industry:—

Lord Essendon (chairman); Capt. H. Leighton Davies (chairman of the Tinplate Conference); Mr. J. E. James (Richard Thomas & Company, Limited); Major Llewellyn David (D. R. David & Company); Mr. John Brown (Iron and Steel Trades Confederation); Mr. P. Owen (Transport and General Workers' Union); Mr. R. G. Lewis (National Union of General and Municipal Workers).

Mr. J. C. Carr, Raw Materials Department, Ministry of Supply, The Castle, Warwick, will act as secretary to the Committee.

Personal

MR. LEONARD LANGRICK, a director of the Coghlan Steel & Iron Company, Limited, has completed 50 years' service with the company.

MR. J. F. DAVIES, deputy chairman and a managing director of Radiation, Limited, has been appointed chairman of the company in succession to the late Sir C. Herbert Smith. Mr. Cyril G. Davis, also a managing director, has been appointed deputy-chairman.

DR. G. E. F. LUNDELL, the head of the Chemistry Division of the National Bureau of Standards, Washington, D.C., has been elected President of the American Society for Testing Materials. Mr. Dean Harvey, of the Engineering Laboratories, Westinghouse Electric & Manufacturing Company of Pittsburgh, is the new vice-president.

MR. ERNEST T. WEIR has resigned as a director of the American Iron and Steel Institute, and has also withdrawn his company, the National Steel Corporation. Mr. Weir was associated with the Institute for many years and was president in 1939-40. Well-informed quarters infer that some of Mr. Weir's policies on wages and prices differed from those of many other steel officials. Last April he initiated the 10-cent per hour wage rise and also indicated that there was no immediate need for higher prices.

Wills

HELE-SHAW, DR. H. S., Emeritus Professor of Engineering at Liverpool University ...	£26,727
ANDERSON, COL. J., of Carluke, director of Anderson, Boyes & Company, Limited ...	£30,137

Obituary

MR. JOHN NEEDHAM, formerly managing director of the Northern Steel & Hardware Company, Limited, Manchester, died recently.

MR. FRANK PROUT, managing director of Lancaster & Tonge, Limited, steam fittings manufacturers, etc., of Pendleton, died on July 5.

MR. ROBERT COWAN, who died at Largs on June 30, was head foreman in the machine shop of John Brown & Company, Limited, Clydebank, for 25 years.

MR. CHARLES HENRY WINTER, of Newcastle-upon-Tyne, a prominent engineer and North-East representative of Head, Wrightson & Company, Limited, Thornaby-on-Tees, has died suddenly while on holiday at Kelso.

Contracts Open

Auckland, N.Z., September 30—Ten 5-ton electric semi-portal jib cranes, for the Harbour Board. Mr. C. R. Butters, agent, c/o H. H. Lloyd & Company, 2a, Guildhall Chambers, 31, Basinghall Street, London, E.C.2.

Birmingham, July 23—Files, hacksaw blades, engineers' tools, belting, etc., from September 1, 1941, to June 30, 1942, for the Corporation. The Engineer and Manager, Electricity Supply Department, Dale End, Birmingham.

Harrogate, August 2—Supply and installation of pumping plant, for Lower Aire Internal Drainage Board. Mr. H. J. Paul, engineer, River Ouse (Yorks) Catchment Board, 7, Langscliffe Avenue, Harrogate. (Fee £2 2s., returnable.)

Neath, July 16—Provision and laying of approx. 600 yds. of 6-in. spun-iron mains, for the Corporation Waterworks. Mr. E. J. Rees, borough engineer, Gwyn Hall, Neath.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Read Engineering Company, Zoar Street, Wolverhampton—£4,000.

Coley Bros. (Tools)—£1,000. S. E. and B. J. Coley, 74, Boden Road, Hall Green, Birmingham, 28.

Hendon Foundry, Edgeworth Close, Hendon, London, N.W.—£2,000. A. F. Ward, E. Barker, and P. T. Davies.

Reports and Dividends

Fisher's Foils—Net profit to April 30 of £2,182, after providing £24,100 in all for depreciation, tax, and reserves; dividend of 5% (same).

Tungsten Manufacturing—Profit to September 30, £6,034; depreciation, £709; bad debts, £7,506; leaving net loss, £1,925 (net profit £544).

Modern Machine Tools—Profit for 1940, £49,900; N.D.C. and tax, £29,048; brought in, £43,957; final dividend of 12½%, making 20%; forward, £52,134.

Edgar Allen—Profit to March 31, £321,739 (£214,570); tax, £263,000 (£125,000); ordinary dividend of 12½% (same); forward, after providing £8,625 (£9,750) for the preference dividend, £36,906.

Metal Industries—Profit to March 31, £162,375 (£182,554); tax and N.D.C., £72,632 (£59,037); final dividend of 2½% on the "A" and "B" ordinary shares, making 5% (same); forward, £107,277 (£98,245).

Triplex Foundry—Profit to March 31, after charging depreciation, taxation, and contributions under War Damage Act, £5,706; preference dividend, £2,372; dividend of 5% on the ordinary shares; forward, £7,862 (£8,278).

John Summers—Net profit for 1940, after depreciation and taxation, £294,856 (£485,465); dividends of 6% (8½%) on the "A" ordinary and 2% (4½%) on the "B" ordinary stock; reserve, £100,000; War Damage Insurance, £30,000; forward, £156,277 (£131,421).

Rotherham Forge & Rolling Mills—Trading profit to March 31, £39,171 (£48,182); balance after taxation, including E.P.T., depreciation, and fees, £14,372 (£18,644); to reserve, £5,000 (same); final dividend of 10% on the ordinary shares, making 15%; forward, after preference dividend, £10,845 (£10,011).

Guest, Keen & Nettlefolds—Profit for 1940-41, £868,000 (£1,003,000), after providing for taxation and charging debenture interest and redemption £97,138 (£98,964) and £200,000 (same) for depreciation; War Damage Act insurance, £40,000 (nil); war contingencies account, including deferred repairs, £60,000 (£100,000 to contingencies); to reserve, £100,000 (£150,000); final ordinary dividend of 2½% (4%), tax free, making 5% (6½%), tax free.

Consett Iron Company, Limited—Trading profit for the year to March 31, £552,238 (against £982,615); interest, rent and royalties, £78,831; bad and doubtful debts, £9,188; fees, £6,658; taxation, £100,000; debenture stock interest, £57,612; brought in, £200,461; depreciation, £125,000; dividend on the 8 per cent. preference stock, £40,000; dividend of 7½ per cent. on the ordinary stock, £210,000; sinking fund, £38,623; investments written down, £30,000; carried forward, £214,448.

Harland & Wolff, Limited—Profit for 1940, after making a provision for contingencies, but before providing for depreciation, £1,122,625 (against £812,247 for 1939); dividends and interest, £19,585 (£4,904); income-tax, £431,409 (£22,426); depreciation, £400,000 (as last year); pensions, £12,976 (£12,941); net profit, £297,825; dividend on the "B" ordinary stock of 6 per cent. (4 per cent.) and on the "A" ordinary of 6 per cent. (same); to reserve, £100,000 (same); carried forward, £98,434 (£96,891 brought in).

Ruston & Hornsby, Limited—Profit for the year to March 31 last, after charging depreciation and including dividends from subsidiary and associated companies, £453,343 (against £345,517 in 1939-40); debenture stock interest, £15,750; net profit for year, £435,771 (£328,583); provision for taxation, £216,412 (£77,273); reserve for contingencies, £25,000; dividends on the 5 and 6 per cent. preference stocks, £23,500; brought in, £75,017; dividend of 12½ per cent. on the ordinary stock (same), £153,750; to general reserve, £25,000; carried forward, £67,126.

John Brown & Company, Limited—Net trading profit for the year to March 13, £591,934 (against £566,157), after providing for taxation and contingencies; debenture interest, £90,000 (£90,232); depreciation, £67,992 (£58,372); fees, £7,005 (£6,285); net profit, £426,899 (£411,338); dividends on the "A" and "B" preference and ordinary shares, £318,247 (£372,094); final ordinary dividend of 9d. per share, tax free (1s. net), making 1s. 3d. net (1s. 6d. net), equivalent to 12½ per cent. (15 per cent.); reserve for contingencies, including War Damage Act, £100,000 (nil); carried forward, £211,027 (£202,376).

Watch this Dictator of Firebrick Life

THERE are some users of refractory bricks who are curiously careless as to the cement they employ. Whilst insisting upon sound and suitable bricks they build them with an inferior cement. They let cement dictate the life and durability of refractory bricks. The shrewd refractory user knows that a dependable cement is worth its cost many times over. Experience shows that in structures jointed with ordinary fireclay, extensive erosion originates in the joints. Joints made with any of the following cements are as hard and mechanically strong as the firebricks.

DURAX No. 3 is a 42/44% alumina, air-setting, high temperature jointing cement suitable for bonding firebrick linings working under high duty conditions. A special feature of Durax No. 3 is its fine grading, which not only gives the cement good "workability" and makes it easy for the mason to use, but also permits a brick-to-brick joint which is so desirable in furnace construction. To obtain the maximum length of service from your firebrick linings, specify Durax No. 3 Refractory Cement for jointing.

PYROLYTE H.T. CEMENT (air setting) for jointing basic bricks in re-heating furnaces, and also for jointing and wash-coating firebricks where furnace conditions produce erosive slag.

DURAX No. 3 REFRACTORY CEMENT (air setting) for jointing and wash-coating all types of firebricks, working under normal and high duty conditions.

SINTEX "D" AND "W" (air setting) for jointing siliceous and semi-siliceous bricks, and also for patching gas retorts and coke oven linings.

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CEMENTS: *Sintex, Durax, Pyrolyte.* PLASTICS: *Durax, Rotaline, Plastic K-N., Glendoline, Ground Ganister, Steel Moulders' Compositions.* SILLIMANITE: Tank Blocks, Bricks and Cements. SANDS: Moulding, Brick Facing, Silica, Glass.

Raw Material Markets

It is evident that rather easier conditions now exist with regard to supplies of certain iron and steel products, but it cannot be expected that there will be any relaxation of the present methods whereby supplies are allocated according to the class of work for which they are required. It has been announced already that future imports of steel from the United States will be on a reduced scale, while purchases abroad of other raw materials will also be brought down to the minimum. Adequate supplies of pig-iron continue to be made available for the light-castings industry, and the heavy foundries, which are mostly engaged on war work, also are well served. Great care, however, has to be observed in the issue of licences to acquire hematite and low-phosphorus iron.

Pig-Iron

MIDDLESBROUGH—Orders on hand at works producing light castings do not permit of very active conditions at these establishments and the future does not hold much promise of any material change in the position, as the war machine has little use for these products and normal outlets have been severely curtailed. Makers can obtain sufficient supplies of iron from the Midlands and in a number of instances have managed to put down small stocks. The easiness of the supply situation in common foundry iron is in direct contrast to the position obtaining in respect of special qualitites, which are used by heavy engineering works. The latter are busily employed on urgent contracts and are consuming substantial tonnages of iron. The Control authorities are, of course, responsible for distribution and have been allocating just sufficient for current needs. In a a good many instances users have been incorporating common foundry iron in their mixtures, thus partially relieving the tightness in other grades. This change in works' practice has been particularly valuable in reducing the demand for hematite, which can only be procured for really urgent business. Although the hematite supply position is somewhat easier than it was, the Control still at times has to make use of imported metal held in reserve.

LANCASHIRE—Demand for pig-iron has perceptibly increased of late and Derbyshire and Staffordshire producers report that speciality engineers are asking for prompt deliveries in addition to placing orders for despatches up to the end of September, which is as far as the Control has granted licences as yet. The heavier requisitions are being made almost entirely by speciality engineers, the position of the light-castings and jobbing foundries being unimproved, owing to the dearth of business for domestic castings resulting chiefly from the virtual cessation of housebuilding operations.

MIDLANDS—The distribution of low-phosphorus and hematite irons is still a matter for considerable care, and home outputs are insufficient to cover the demand. No interruption of work is occasioned on this account, however, as the Control are supplying foreign iron where this is absolutely essential, while some users have rearranged their mixtures to incorporate high-phosphorus and refined irons, which are fairly plentiful. Steel scrap, too, is proving a useful substitute for the better class irons. The heavier demand for high-phosphorus iron which has lately been apparent is due more to the greater use of this type of iron by the heavy engineers than to any quickening of activity in the light-castings trade, which remains dull. Business in domestic castings is not likely to revive until after the war, when it may be expected that the demand will assume a high level, in view of the widespread schemes of building and reconstruction.

SCOTLAND—Brisk activity is reported throughout the heavy engineering industry, and consumers are taking up substantial tonnages of pig-iron. Licences are issued quite freely in this section of industry, as the works are generally fully occupied with orders for Government departments. Only current needs are being delivered in most instances, and little, or no, provision is made for the accumulation of stocks. Although the light-castings founders have recently completed a week's holiday, they are still quietly employed. Adequate supplies of foundry iron are coming forward from the English Midlands.

Coke

Production at the coke ovens is easily able to look after consumers' requirements, which are substantial and considerably above the normal level. The larger consumers, in particular, are unlikely to be short of supplies next winter, as they have been able to lay down quite extensive stocks which will stand them in good stead should delivery interruptions be experienced later in the year. For delivery to stations in the Birmingham and Black Country districts, the current price of Durham best foundry coke is 62s. 9d. per ton.

Steel

Consumers of steel have generally been receiving rather improved supplies of late, but this does not herald even the slightest relaxation in the present strict conditions governing distribution. Almost the total output of steel in this country is accounted for by urgent Government contracts, while it has recently been made clear by the Control authorities that less steel will be imported from the United States in the future, as, despite the fact that steelworks there are operating at around 96.5 per cent. of capacity, the pressure on American industry in connection with defence business is so great that the demand for steel is at an unprecedented level. There are ample stocks of raw and semi-finished steel in the United Kingdom to meet all priority requirements over some time to come, while producers are straining to add to their already magnificent outputs. Makers have heavy orders on hand in most instances, but the structural steel demand continues to be comparatively quiet.

Scrap

Owing to the inadequacy of home-produced supplies of iron and steel scrap, it is still necessary for imports to be made from the United States. Nevertheless, there has been some improvement recently in the distribution of scrap found in this country, and consuming works are reaping the benefit of better deliveries. Unfortunately, however, there has been little opportunity to stock on any appreciable scale, so that works are largely operating on a hand-to-mouth basis. A few buyers have had to suspend deliveries for a short time whilst stocktaking is being carried on, but this stoppage is only of a temporary nature, and the works will soon again be in the market for all the scrap they can acquire.

Metals

COPPER—Large orders for copper are being placed by consumers engaged on contracts associated with the war effort and, although these are being satisfied promptly, there is nothing to spare for ordinary domestic users of the metal. Empire copper has been reaching our shores with commendable regularity despite the hazardous nature of the sea routes, and it may be expected that the joint occupation of Iceland by British and American forces will assist in ensuring a safe passage for future shipments.

The June statistics issued by the American Copper Institute are as follow:—Production of crude copper, 82,674 tons, against 90,292 tons in May; production of refined, 88,560 tons (89,390); deliveries to domestic consumers, 115,097 tons (141,801), of which Latin-American copper totalled 31,667 tons (49,190); export shipments, 42 tons (nil); refined stocks at the end of June, 98,164 tons (95,568).

TIN—Confirmation of reports that Russia had made purchases of Straits tin last week has been received in London tin circles, although details are still lacking. As yet it is thought that the U.S.S.R. have not been in the market for large supplies. Advices from New York indicate that Soviet agents there have been endeavouring to fix shipments of both tin and rubber from the East. On the London market sales by smelters have again been a feature. Mainly due to the prohibition on the export of tin from the United Kingdom, stocks here since around the beginning of May last have increased by about 100 per cent. An increase of 346 tons to 4,086 tons in the U.K. latest official figure was due to smelters putting a very large amount of metal into warehouse, reported to total some 1,025 tons, when deliveries were around normal. Limitation of supplies of steel to the tinplate industry is severely restricting operations in that trade and, consequently, tin consumption is at a comparatively low level. It would appear that the output of tin smelters in this country is fully adequate to satisfy all requirements. The quantity of ore arriving in the United Kingdom is, of course, reduced, as Bolivian producers are despatching large tonnages to the United States.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £257 5s. to £257 15s.; Friday, £258 15s. to £259; Monday, £258 10s. to £258 15s.; Tuesday, £257 15s. to £258; Wednesday, £256 15s. to £257.

Three Months—Thursday, £261 to £261 5s.; Friday, £261 10s. to £261 15s.; Monday, £261 5s. to £261 10s.; Tuesday, £261 5s. to £261 10s.; Wednesday, £260 5s. to £260 10s.

SPELTER—The zinc supply position remains on the tight side, as there is barely more than enough to meet urgent priority demands. Shipments are coming to hand from Empire sources and the United States, and production is being expanded where possible, so that no shortage should be experienced in the future. The American market, also, is tight and very substantial tonnages of the metal are being absorbed by defence contracts. The United States output of zinc in June is reported at 32,236 short tons, against 64,651 tons in May. Deliveries were 63,159 (63,638) tons, while stocks at the end of the month were 7,404 (8,305) tons.

LEAD—As stated in our last issue, the lead supply position in the United States is tending to become somewhat tighter and the U.S. Government is seeking to obtain additional imports. This is likely to be reflected in the United Kingdom by a new system of distribution whereby non-essential users will find it less easy to acquire metal.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

533,177 WILLIAMS, W. P. (Armco International Corporation). Induction furnace and method of heating.

533,178 MACMILLIN, H. Presses for drawing sheet metal or the like.

533,199 SOC. D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE, ET DES ACIERIES ELECTRIQUES D'UGINE. Tapping molten metal from furnaces.

533,247 SVENSKA TURBINFABRIKS AKTIEBOLAGET LJUNGSTROM. Method of and apparatus for testing the tensile strength of materials.

533,261 HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, W. T., BARRY, W. C., and TUNSTALL, H. A. Cast metal pipe joints.

533,751 HALKYARD, C. C., and HUME STEEL, LIMITED. Pipe joints.

533,760 SPURWAY, F. G. Manufacture of electrically-welded metal tubing.

533,774 SHORTER PROCESS COMPANY, LIMITED (Linde Air Products Company). Apparatus for heat-treating metal bodies.

533,780 INTERNATIONAL DE LAVAUD MANUFACTURING CORPORATION, LIMITED. Mould-coating apparatus for centrifugal moulds for casting metals.

533,810 KELLY, T. D. Electric-arc furnaces.

533,697 PHILIPS LAMPS, LIMITED. Method of and device for reproducing cross-sections of bodies by means of X-rays.

533,703 SOC. D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE, ET DES ACIERIES ELECTRIQUES D'UGINE. Manufacture of steel or alloy steels.

533,724 DANIELS, F. C. T. Method of casting iron rolls.

533,747 ELECTRIC FURNACE COMPANY, LIMITED, and HOWARD, J. C. Electric furnaces of the induction type.